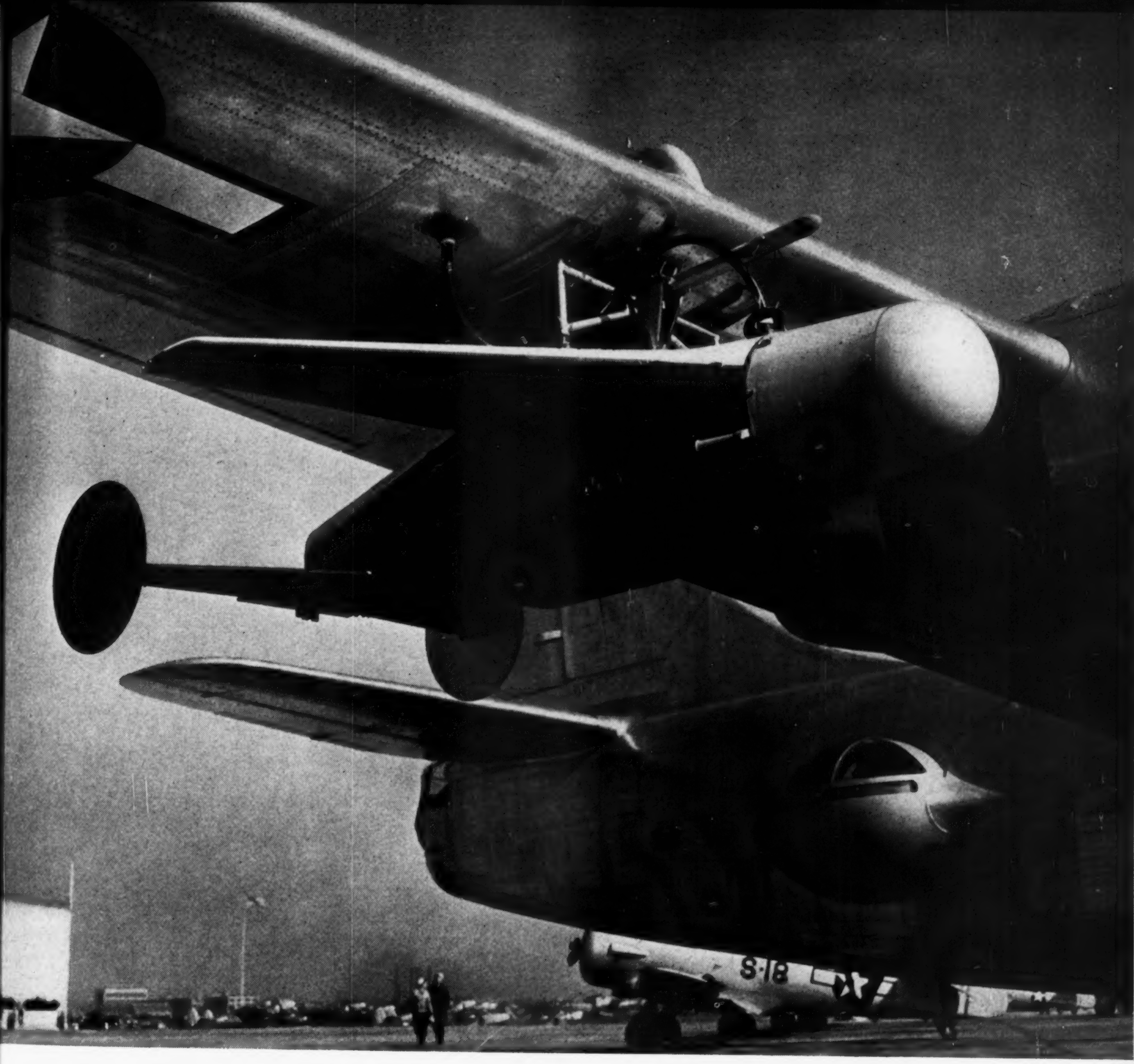

BELL LABORATORIES RECORD

VOL. XXIV NO. 4 APRIL 1946

A monthly magazine for members of Bell Telephone Laboratories, for their associates in the Bell System and for others interested in the progress of the communication art.

CONTENTS OF THIS ISSUE

PAGE

The Cover—One of the two wing-carried "Bats" ready for launching beneath the wing of a giant *Privateer* patrol bomber.
—*U. S. Navy Photo.*

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BELL LABORATORIES RECORD

APRIL 1946 VOLUME XXIV NUMBER IV

The Bat—Radar-Controlled Glide Bomb

THE BAT, a high-speed glide bomb with a TNT punch and an electronic passion for stalking elusive targets, has emerged from the Navy's confidential files as one of the war's most tenacious new weapons. Gliding down out of the sky, this radar-controlled, pilotless missile would follow a ship's most violent evasive action until their pathways merged in a final, consuming explosion.

Also revealed now is that the radar device by which the Bat successfully tracked and crash-dived many tons of Japanese shipping during the last year of the war was designed by the Laboratories and mass-produced by Western Electric.

The idea behind this almost human weapon is roughly akin to that used by ordinary animal bats, which guide themselves by listening to the echoes of super-sonic pulses which they emit in flight. It is from this analogy of the animal world that the new weapon derived its nickname. The Navy's electronic bat accomplishes the same result with radar pulses, first transmitting them and then using the reflected signals to guide a missile to the reflecting object.

Study of such missiles was begun in April, 1942, by the Navy Bureau of Ordnance and the National Defense Research Council, with the latter responsible for development and design of an airframe and an automatic pilot, as well as preliminary work on a method of radar control. In January, 1943, at the Navy's request, Bell Laboratories began work on the radar-control aspects of the problem and agreed to build a preliminary set for testing ten months later, if possible, and then to produce five models of the radar equipment for delivery six months after that.

The first model of the Bat's eyes and brains was a large, complex hook-up of tubes, circuits, resistors and such. Ready for testing by the deadline, it was mounted in a model glider slung under the wing of a Martin *Mariner*, a big twin-engine flying boat. Engineers came squarely against the big problem of testing a device whose function is accomplished through suicide.

As J. G. Chaffee, senior circuit engineer for the Bat, phrased it: "You can't test it to

The photograph above shows a *Privateer* with two Bats under its wings—*U. S. Navy Photo.*

the bitter end. If you let it go, you lose your model, and you'll never know why it worked, or why it didn't—if it didn't."

The problem was resolved by flying the *Mariner* along the course indicated by the Bat's radar, approaching the target as closely as possible without actual collision.

There were still some packaging requirements. They compressed the unit into neat, compact packages that would fit inside the missile's nose. Included were a transmitter, a receiver and the circuitry that indicated the direction of the target and electrically flashed its findings to the glider's autopilot.

Another part of the unit, the monitor, was mounted in the mother plane which carried the Bat to the scene of action. This monitor presented signals from the Bat to the pilot and radar observer, so that when the Bat picked up a ship, a tell-tale "blip" appeared on the monitor's scope.

The pilot then headed his plane—and with it the Bat—toward the target ship. Then, through controls in the plane, the glider's radar apparatus was "clutched in" on the target and the Bat was released. From that point, it directed itself. If the target ship moved or changed its course, the Bat knew it a split second later and changed its own accordingly.

The Navy placed an order for several hundred. Thirty-five were to be built on a pre-production basis at the Laboratories and the remainder at Hawthorne. By the time the first set left the Western Electric production line in July, 1944, Navy orders had increased again and they reached several thousand by the end of the war.

Method of attaching radar-controlled glide bomb to wing—U. S. Navy Photo

By the autumn of 1944, the Navy decided it had enough sets to try "bitter end" testing, using an old Liberty ship as a target.

The field trial of the Bat was an event the Laboratories engineers had awaited for months. Eleven were dropped during the first series of tests. One scored a direct hit on the target and two more landed a few feet short and skipped into it. Of the others, four skimmed over the vessel, three fell short and one went wild in a crosswind. The Bat had the right idea but its homing instinct needed sharpening.

Bell engineers were up against the same old problem. How do you know what is happening inside a pilotless missile on its way to destruction? Once you release it, it's gone. So they fastened the radar equipment on the front of a blimp gondola, and with a daring young man astride it to watch its operation and motion picture cameras to read various test meters, they cruised slowly toward the target. On the basis of this and other tests and considerable good, sound theory, various improvements were made.

By early 1945, final trial releases were completed and the Bat was given orders overseas. *Privateer* search planes equipped to carry Bats appeared on Philippine airstrips in May of that year. To date, the Bat's combat record against Japanese shipping has not been revealed in detail, but one incident, in which two planes spotted two Jap destroyers, has been disclosed. When the planes closed in they were met by intense anti-aircraft fire. They retreated out of range, and from this distance, one of them launched its Bat which blew the bow off the leading destroyer.

The radar-guided bomb is about 12 feet long, has a 10-foot wing spread and carries half a ton of high explosive.

R. C. Newhouse supervised circuit design and served as project engineer during the developmental and the later production phases. E. T. Mottram headed mechanical design and was project engineer from the time of the production phase in the Laboratories until after the first thirty-five sets were delivered and production was under way at Hawthorne.

A Wide-Angle Fastax

By J. H. WADDELL
Photographic Engineering

FOR studying the action of relays, step-by-step switches, and other fast-moving electrical apparatus, the Laboratories several years ago developed two types of high-speed motion-picture cameras. The first employed 16-mm film and took up to 4,000 pictures a second, while the second used 8-mm film and took up to 8,000 pictures per second. With the intensified war development following Pearl Harbor, demands for these cameras outside of the Laboratories became so insistent that the Western Electric Company took over their manufacture under the registered trade mark of Fastax.* With a 35-mm lens, which is an accessory lens with these cameras, the angle of view for the 16-mm camera is sixteen degrees, and for the 8-mm camera is eight degrees. Although these angles are large enough for many purposes, they proved rather narrow in some situations, particularly where the camera had to be used close to the subject. A wider angle was particularly desired for ballistic studies, and it was decided to design a camera similar in general arrangement and operation to the Fastax, but with an increased angle of view.

By changing to 35-mm film, the width of the picture could be increased from the 0.4 inch of the 16-mm film to 1 inch, which increases the horizontal angle of view from sixteen to forty degrees. For most of the work for which these cameras were to be used, there is no advantage in increasing the vertical angle of view, and thus the 0.30-inch frame height of the 16-mm film would have been satisfactory had there been no other requirements. It is frequently desirable, however, to project the film taken, and to make this possible, the height of the frame should span a whole number of perforations along the edge of the film.

With standard 35-mm film, the frame height is 0.75 inch, and there are four perforations in this distance along the edge of the film. With a frame height of 0.3 inch, on the other hand, there would be only 1.6 holes per frame. By increasing the frame height to .375 inch, however, there would be two perforations per frame. Then, by changing the drive sprocket on the projector from sixteen to eight teeth, one-quarter revolution would move the film up just one frame, and proper projection would be secured.

This change in frame height, however, required a number of changes in the camera. In the Fastax camera, the film is carried continuously and at high speed along the focal plane of the lens, and a rotating prism between the lens and the film moves the image at the same speed as the film, thus holding the image stationary with respect to the film during each exposure period. With a frame height of 0.375 inch instead of 0.3 inch, however, there should be four pictures on the length of film that would normally have had five, and to bring about this change, the gearing between the drive sprocket and the prism must be changed from a five to one to a four to one ratio. With this reduced speed, however, the speed of the image would be less than

*Record, *September*, 1943, *page* 1.

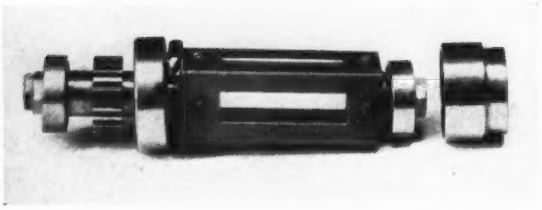


Fig. 1—Prism assembly that was designed for the wide-angle Fastax

Fig. 2—The prism is mounted between the film sprocket and the housing

that of the film, and blurring would result. It was necessary, therefore, to increase the velocity of the image without increasing the speed at which the prism rotated.

To secure this increase in speed of the image while retaining the lower rotational speed of the prism, a rare-element glass having a higher index of refraction was used for the prism. The thickness of the new prism is also slightly greater, but practically all the desired increase in the velocity of the image was obtained by the increase in refraction index.

Other changes were required because of the increased length of the prism—more than twice that of the prism for the 16-mm camera. With this latter camera, the prism is held along its four edges by a housing fastened to the end of a short shaft, and overhangs its bearings. With the much greater length of the prism required for the wide-angle camera, it was not felt desirable to have the prism overhang its bearings because of the danger of whipping. An additional bearing was thus provided beyond the prism. Furthermore, the greater length of the prism made it desirable to strengthen the housing to decrease the likelihood of its breaking from the effect of centrifugal force. The housing consists of two ends fastened to the shaft and four connecting angle pieces that fit over the edges of the prism. Under the action of centrifugal force, these angles tend to deflect outward. They act like beams with uniformly distributed load, and when such beams are increased in length, their deflection and tendency to break also increase. The new housing with its bearing and drive pinion is shown in Figure 1, and the position of this unit in the camera is shown in Figure 2.

The drive sprocket of the new camera is similar to that of the 16-mm camera, with the pitch and rectangular tooth shape designed to use film that has not shrunk more than 0.5 per cent. If, due to improper storage for long periods, the film has shrunk

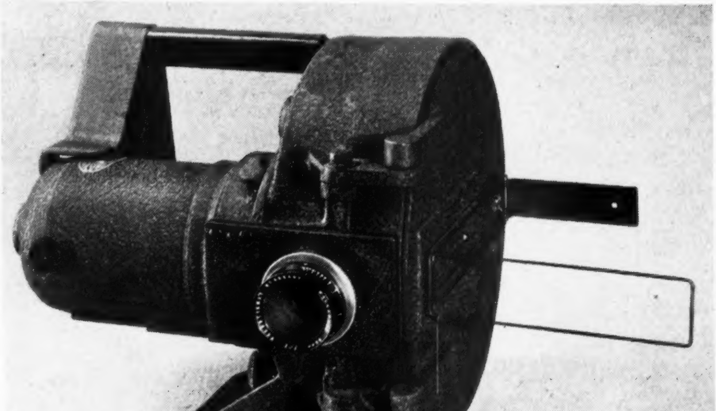


Fig. 3—The direct view finder when not in use folds flat against the cover of the camera

more than this amount, it will tend to ride on top of the teeth of the sprocket—leaving the focal plane and tending to be driven irregularly. To permit a ready check of the shrinkage of the film, two pins spaced thirty-eight perforations apart are mounted on the inside of the hinged cover of the camera. These serve as a film gauge. Film having a tolerable shrinkage will fit over these two pins satisfactorily.

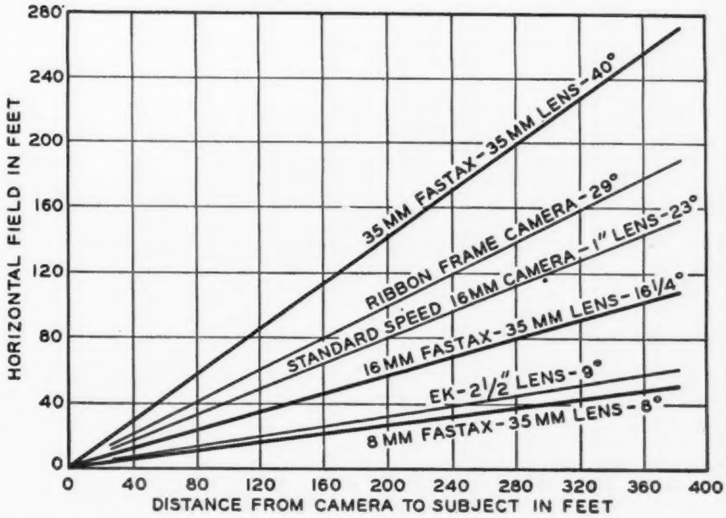


Fig. 4—Fields of view of high-speed cameras

Two view finders are provided with this new camera. One, shown in Figure 3, is a peep-sight view finder for use with the 35-mm lens when focussed at distances of about 25 feet or more, and is intended as a convenient means for checking the field of view. The other finder, shown in the photograph at the head of this article, is of the reflex type, and fits into the lens mount on the front of the camera. To use this finder, the 35-mm lens is removed and is inserted in the finder socket. Two focussing scales are provided on the lens. The red scale, used with the view finder, corrects for the difference in distance between the subject and the finder screen, and the subject and the film plane. A seven-power magnifier furnished with the finder serves as an aid in focussing. When the proper focus has been determined from the red scale, the finder is removed, the lens is replaced on the camera, and the white focussing scale is adjusted to the setting previously obtained on the red scale.

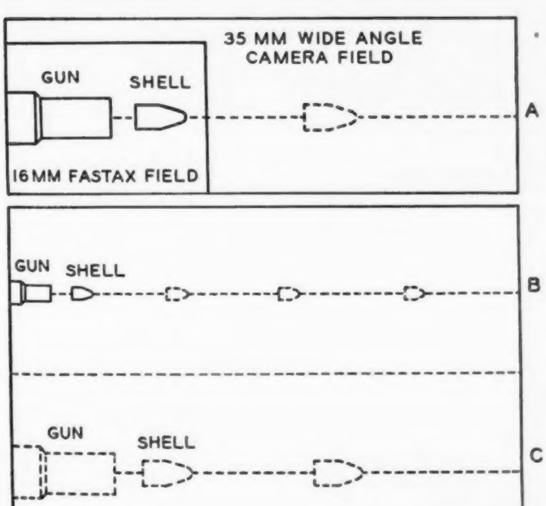


Fig. 5—With the same distance between camera and subject, the field of view for the 35-mm camera is two and one-half times that of the 16-mm camera, as shown at A. When the distance of the 16-mm camera is changed so as to include the same field of view in both cameras, the size of the subject with the 35-mm camera, C, is two and one-half times that of the 16-mm camera as shown in B

The new camera is equipped with an F/2 35-mm lens, but there are also available an F/2 2-inch lens, an F/3.5 105-mm lens, an F/4.5 150-mm lens, and an F/4.5 254-mm lens—all readily interchangeable. All lenses are coated. It has been found by experience that approximately two stops effective increase in aperture is obtained by using coated lenses because of the reduction of internal reflections in the lens and the resulting higher transmission. The absence of flare, which is a characteristic of these coated lenses, facilitates the photography of incandescent subjects.

The camera has been designed to withstand reasonably rough usage, and can be employed in studies where blast pressures are many times greater than those that can be tolerated by man. It is light in weight (about thirty-five pounds) and can be used in any position that insures proper posi-

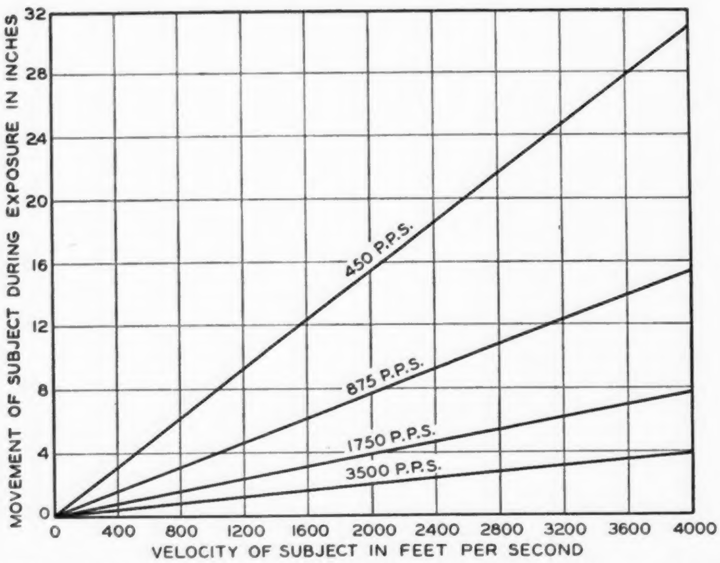


Fig. 7—Movement of subject during exposure for various speeds of the subject and the film

tioning of the film reels on their supporting spindles within the case.

Like the earlier Fastax cameras, this camera has two similar 110-volt motors which operate on either a-c or d-c. One drives the film sprocket and the other the take-up reel. Speed is varied by changing the voltage impressed across the motors—with an autotransformer when a-c is used and with an adjustable resistor when d-c is used. Maximum speed is 3,500 pictures per second which is a little lower than that of the 16-mm camera.

The field of view of the wide-angle Fastax relative to that of other high-speed cameras is shown in Figure 4, while Figure 5 gives a more detailed comparison of the fields of view of the 16 and 35-mm Fastax cameras. In A, the distance between the camera and the subject is the same for both the 16 and 35-mm cameras, and as a result, the width of the area covered by the 35-mm camera is two and one-half times that covered by the 16-mm camera. In B and C, for the 16 and 35-mm cameras, respectively, the distance to the subject is increased for the

Fig. 6—A rocket launching taken at 3,500 frames per second. The rocket was travelling at 1,000 feet per second at the time ➡

16-mm camera so as to include the same field of view. Under these conditions, the size of the subject on the 35-mm film is two and one-half times as great as that on the 16-mm film.

The camera has proved extremely useful in ballistic studies where satisfactory photography in direct sunlight at F/3.5 is possible at speeds of 3,500 pictures per second. It is, of course, necessary to exercise care in judging the sunlight. In central United States and on the Eastern Seaboard, conditions for taking pictures at 3,500 per second would exist from approximately April to September, while in Arizona, California, or Florida, suitable pictures should be obtainable all year round at this speed. Pictures have been obtained in Florida at speeds of 4,000 per second, using the same optical system and natural sunlight, when the subjects were eight feet under

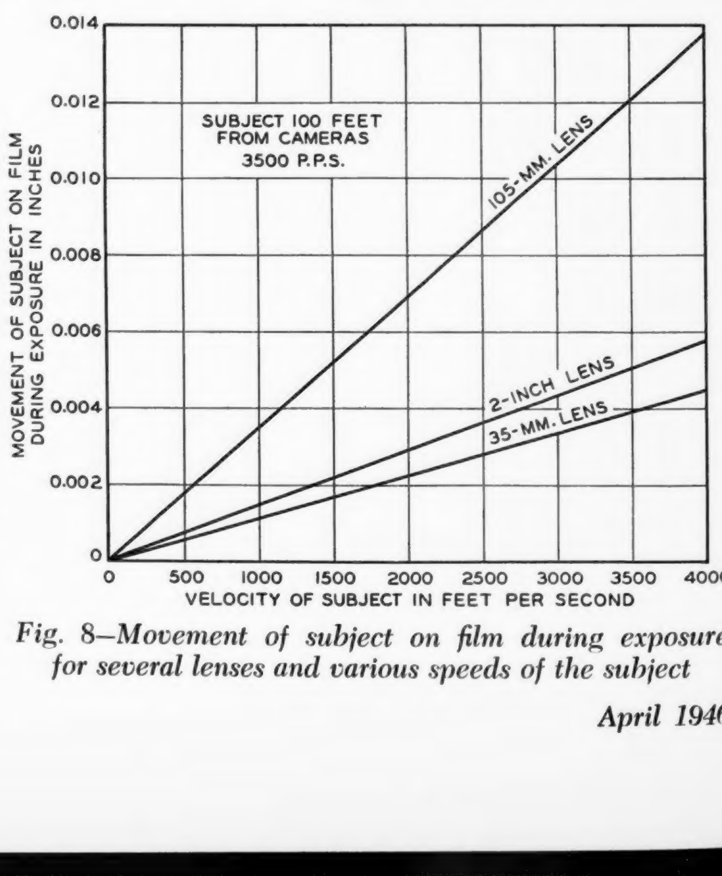
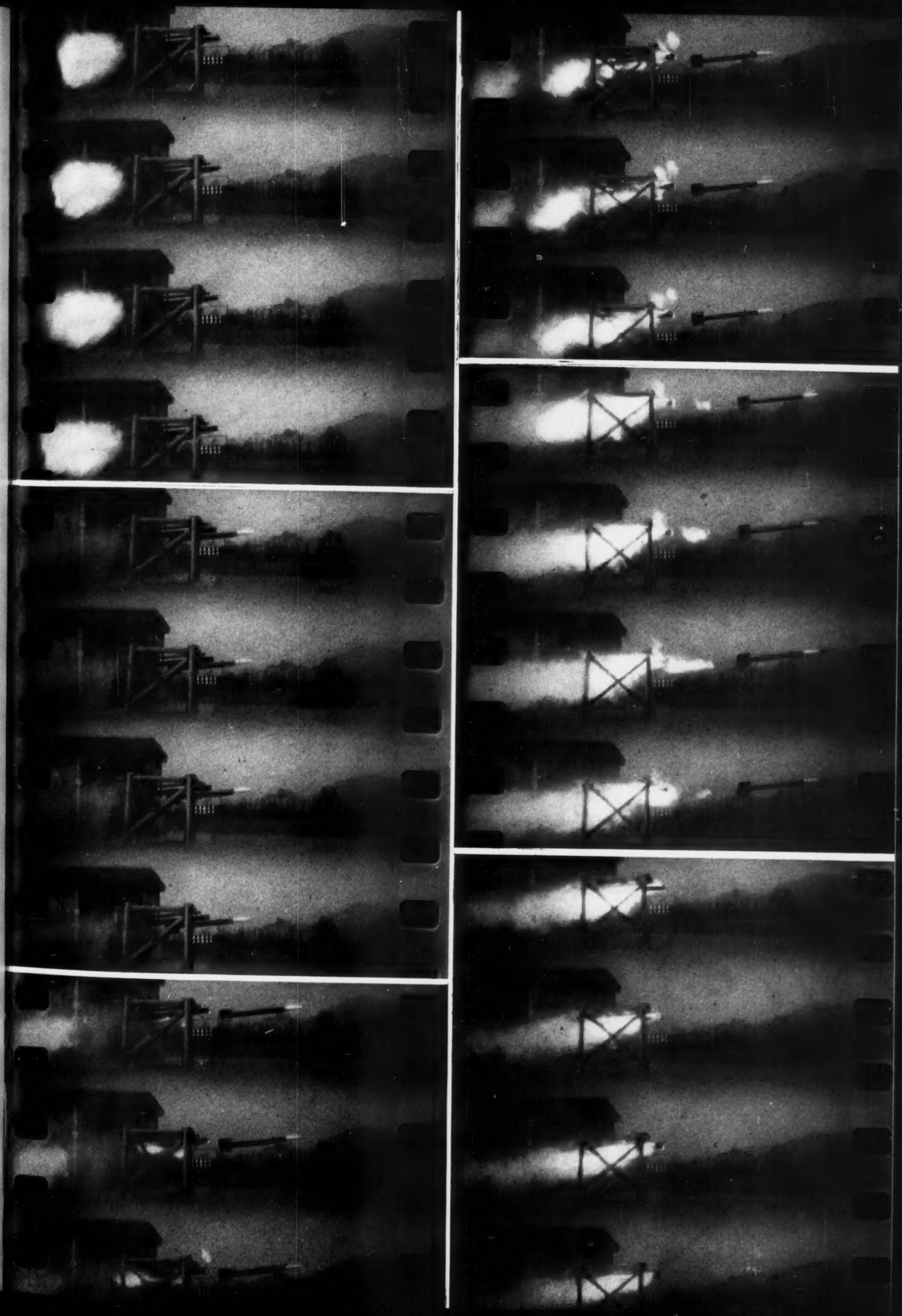


Fig. 8—Movement of subject on film during exposure for several lenses and various speeds of the subject

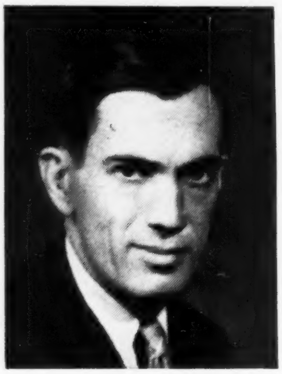


water. Figure 6 shows several strips of pictures of a rocket launching taken at the rate of 3,500 per second. The rocket was traveling 1,000 feet per second at the time.

In photographing a continuously moving subject, there is always some displacement of the subject during the short exposure times. How great this is for various picture speeds is plotted in Figure 7 against the speed of the subject. The corresponding movement of the image on the film is shown in Figure 8 for several possible lenses. For this latter figure, it is assumed that the camera is perpendicular to the line of motion of the subject and is 100 feet from it.

In addition to the more conventional applications, the 35-mm camera has been used for recording high-speed oscillographic traces. For such purposes, the camera is used without a prism, and the lens plate is corrected to compensate for the resulting difference in back focus. Complete wave traces have been taken of alternating potentials up to 200 kc in frequency and at film speeds up to 120 feet per second. With such pictures and a film viewer, time measurements are possible to an accuracy of less than one microsecond. Figure 9 shows such a trace of a 200-kc voltage which has been superimposed on a 2,500-cycle voltage.

THE AUTHOR: JOHN H. WADDELL joined Bell Telephone Laboratories in 1929 after having been with the duPont Film Manufacturing Corporation. He had studied chemistry at Pennsylvania State College, and during the period of our active work in sound pictures, he worked on the physics and chemistry of film developing systems in the sound picture laboratory. Since that time he has been engaged in photographic and optical engineering work, chiefly in designing cameras of both the recording and slow-motion-picture type, and in developing photographic techniques for special applications in the Bell System and Armed Forces.



Kjeldsen-Hawthorne

As already indicated, pictures made with the 35-mm camera described here have proved very helpful in the analysis of many kinds of problems, and the wide-angle Fastax camera has found a wide variety of applications. This camera is being manufactured and sold by the Western Electric Company as a service to the research and industrial development program of America.

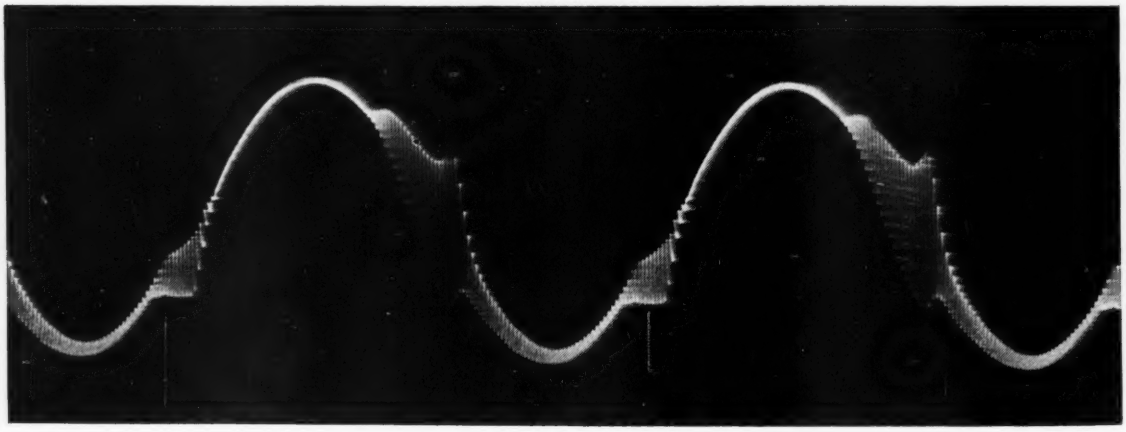
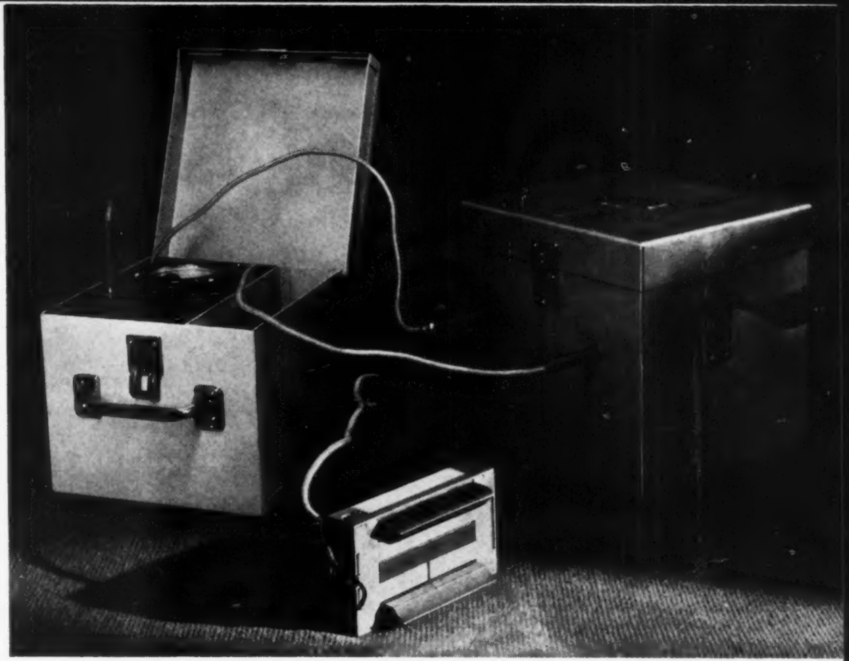


Fig. 9—Oscillographic trace of a 200-kc voltage superimposed on a 2.5-kc voltage

Exploring Coils

By T. C. HENNEBERGER
Outside Plant Development



WHEN a cable wire accidentally comes in contact with the cable sheath or another wire, the general procedure for locating the trouble is to measure the resistance of the faulty wire from one end of the cable to the fault, using a Wheatstone bridge. This resistance is then translated into distance, so many feet to the ohm, and the location is spotted on the cable record map. If the measuring conditions are reasonably favorable, the location thus obtained is accurate within, say, fifty feet. Sometimes a cableman, sent out to repair the damage, can find the trouble by inspecting the cable in the indicated area, particularly if the sheath is obviously damaged. Sometimes, however, there is no clearly discernible indication of the point of fault, and to avoid the necessity of making several sheath openings to find the trouble, an exploring coil is used to seek out the exact location.

The theory of running down faults by the exploring coil method can be understood by reference to Figure 1, which shows a cable wire assumed to be in accidental contact with the sheath (i.e., grounded) at some point remote from the ends of the cable. A tone source, connected to the wire at one end of the cable, causes a tracing current to flow along the wire, through the fault, and back through the cable sheath.

If, now, the exploring coil is held against the cable sheath at a point between the tone source and the fault, the magnetic field produced by the tracing current will be detected by the coil and telephone receiver. On the far side of the fault there will be no tracing current and no magnetic field. Thus, by applying the coil at various points along the cable and comparing the tone volumes, the location of the fault can be determined.

Actually, things are not so simple as this. The tracing current, on passing through the fault and arriving at the sheath, does not all flow along the sheath directly back to the source. Some flows along the sheath toward the distant end of the cable, finally returning to the source through earth, as indicated in Figure 2, and unless the coil is designed to be "neutral" to sheath currents, therefore, a tone would be heard on both

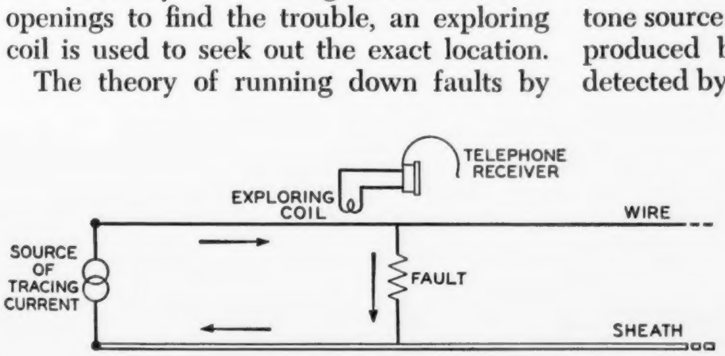


Fig. 1—Graphic indication of method of locating faults with an exploring coil

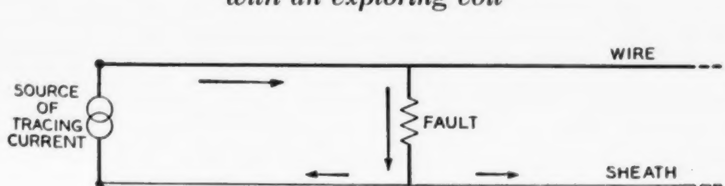


Fig. 2—In actual tests the situation is complicated by leakage paths to ground from the sheath

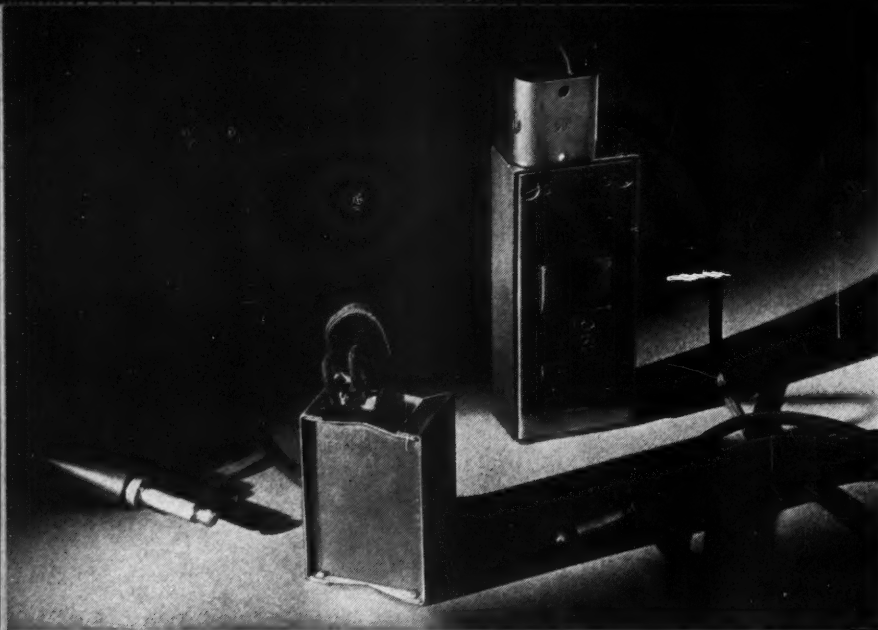


Fig. 3—The 75A (left) and 19C test sets

this field, and thus parallel to the axis of the cable. The coil, held against and along the sheath in position neutral to any sheath current field, is therefore neutral also to that component of wire current field parallel to the sheath current field, and detects only the small field component parallel to the cable axis.

Under such conditions, the efficiency of pick-up is low. In days gone by, low efficiency was compensated for by using a powerful tracing current. This is no longer practicable because such a strong current with its resulting strong magnetic field would cause excessive noise interference on modern types of telephone circuit. The approved tone source of today (76B test set) contains a vacuum tube oscillator operating at a frequency of 500 cycles per second with a "warble" of 7 cycles per second. The output is carefully controlled in volume and in wave shape. For detection, a portable vacuum tube amplifier, the 107A amplifier,* is connected between coil and receiver to bring the volume to a satisfactory listening level.

sides of the fault. Neutrality with respect to the sheath current is obtained by utilizing the fact that the magnetic field caused by sheath currents is equivalent to that which would be produced by a wire coinciding with the longitudinal axis of the cable; and designing the coil so that, when held in position on the sheath, the magnetic field resulting from such currents does not affect the coil windings. Since the cable wires are spiraled around the axis of the cable, the magnetic field resulting from current in one of them is at a small angle with that caused by current flowing in the sheath. As shown graphically in Figure 4, this magnetic field may be considered as having two components, one parallel to that resulting from sheath currents, which is perpendicular to the sheath axis, and another, much smaller, at right angles to

Even Figure 2 is not a complete representation of the condition, because there is capacitance between conductor and sheath throughout the length of the cable, and part of the tracing current flows to ground

*Record, *January,* 1939, *page* 155.

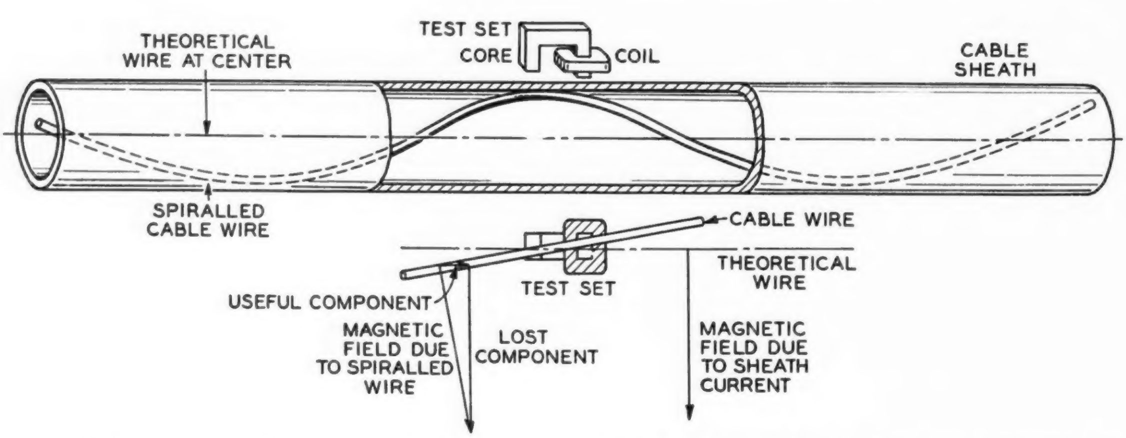


Fig. 4—Current in the cable sheath has no effect on the test set indication because the exploring coil acts only on the component of the field at right angles to the axis of the cable

through this capacitance. This is indicated in Figure 5. The capacitance to ground of the length of wire beyond the fault acts as a shunt on the fault resistance, and causes a portion of the tracing current to flow on the wire beyond the fault, as indicated by the arrows. The longer the length of cable beyond the fault, and the higher the fault resistance, the greater is this "carry-over" current, and the smaller is the ratio of tone pick-up volumes on the two sides of the fault. On exchange cables of average length, fault resistances up to several thousand ohms provide sufficient tone volume ratios for positive identifications. On long trunk cables in exchange areas, and on toll cables, carry-over, and also the attenuation of the tracing current between source and fault, are such serious factors that it is necessary to use a tracing current of very much lower frequency than for short cables.

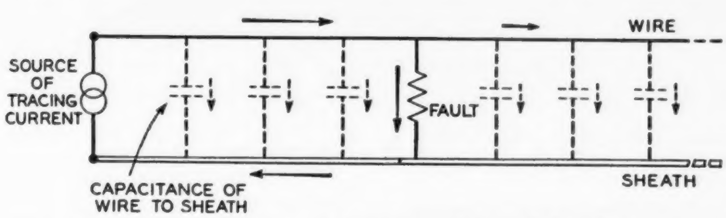


Fig. 5—Conditions are further complicated by the capacitance current between conductor and sheath

The source of tracing current for long cables is the 20-cycle ringing generator of the central office. An exploring coil especially adapted to pick up 20-cycle magnetic fields is used by the cableman. Since 20 cycles is practically inaudible, an amplifier-detector with a meter in its output circuit is used as the volume indicating means in place of a usual amplifier and telephone receiver.

These exploring coil methods of locating faults have been in use on short and long cables for a number of years with satisfactory results. Recently, however, it has appeared desirable to redesign the apparatus employed to secure reduced weight and greater convenience in manipulation. The 75A test set was designed primarily as the exploring coil for short lengths of cable to supersede the older 19C test set. These two coils are shown in Figure 3.

The exploring coil apparatus for toll cable has also been extensively redesigned. In place of the older 46A test set, consisting of a tuned amplifier-detector contained in a large box, there is now the 78A test set, which provides a tuned input circuit and a tuned output circuit for the already available 107A amplifier. The output circuit includes a varistor and meter for rectifying and measuring the pick-up of the exploring coil. The weights of the 78A and 107A amplifier are approximately 10 pounds each, as compared with 50 pounds for the 46A set. The new exploring coil differs from the one used with the older apparatus only in the minor modifications necessary to adapt it to the new outfit. In the photograph shown at the head of this article, the 78A test set is shown at the left, the 107A amplifier at the right, and the twenty-cycle exploring coil in the center foreground.

These new or improved fault locating test sets are representative of the additions that have been made recently to an important kit of tools—the kit of the cable splicer and maintenance man. Other electrical testing items of the kit have already been described previously.*

*Record, *February*, 1941, *page* 195.

The Author: T. C. Henneberger was graduated from Lehigh University in 1921 with the degree of electrical engineer. For the following thirteen years he was a member of the D & R engaged in work on outside plant construction and maintenance problems. After his transfer to the Laboratories in 1934, he was in charge of the group handling the development of electrical apparatus for outside plant use. During the war he was engaged in the development of special apparatus for the Navy. At present he is Field Requirements Engineer of the Outside Plant Development Department.

Historic Firsts: The Coaxial System

UNTIL the early years of the present century, developments in telephone transmission were concerned primarily with improving transmission over the ordinary range of voice frequencies. The invention of radio telegraphy during the closing years of the 19th century and the improvements in the vacuum tube during the early years of the 20th century provided stimuli and instrumentalities for the transmission of high frequencies. They thus created incentives for the development of carrier transmission, which had been incubating since before the time of Alexander Graham Bell. Commercial carrier-telephone systems began to be installed during the second decade of the century. Their success opened the gates to a flood of developments in high-frequency transmission systems that during the past twenty-five years has revolutionized the entire structure of electrical communication.

Although the carrier systems as used or projected at that time greatly increased the message-carrying ability of telephone lines, there were difficulties that far-seeing engineers recognized would limit the fullest use of the carrier method in the rapidly growing communication art. The more carrier channels provided over a single circuit, the higher must be the top frequency. As the frequency increases, however, the greater becomes the attenuation of open-wire lines and cable pairs, and the greater also becomes the difficulty of avoiding crosstalk between channels and systems. Some system more naturally adapted to the transmission of high frequencies was needed, and the prospect of television added to this need, since it would require a frequency band of the order of millions of cycles per second, a frequency then thought of as exclusively within the province of radio.

Anticipating this need, and using their imagination and their knowledge of high-frequency systems, Lloyd Espenschied and Herman A. Affel conceived the coaxial carrier system. A patent was applied for early in 1929, and Patent No. 1,835,031 was granted on December 8, 1931. Although the coaxial form of line had long been known as a structure at low frequencies, as in submarine cables, and although the larger air-insulated kind of coaxial structure had been employed for leading a radio channel from an antenna into a building, there was now to be realized a new kind of wire system capable of transmitting a continuous range of high frequencies over long distances, using broad-band repeaters.

Field tests were undertaken to prove that the desirable theoretical properties of such a high-frequency line could be realized in practice. Then there was developed a practical kind of small flexible cable and also the terminal apparatus required for piling hundreds of telephone channels on top of each other and separating them again; and similar terminal apparatus for handling the continuous wide band required for television. Small broad-band amplifiers to be applied at intervals along the coaxial structure were an essential part of the development.

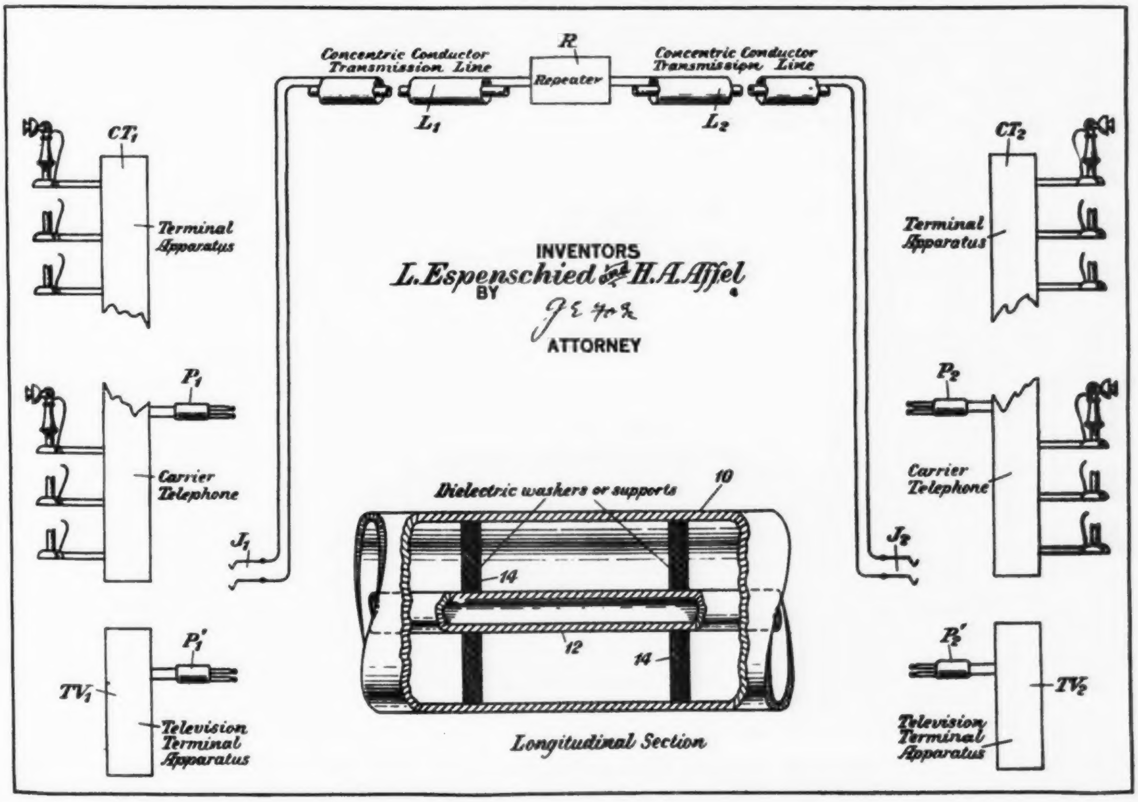
By 1934, sufficient progress had been made to warrant announcing the development in an engineering paper presented before the A.I.E.E. by Espenschied and M. E. Strieby. This initiated interest abroad in the new type of facility. An actual installation was then made between New York and Philadelphia. In November, 1936, transmission over a 3,800-mile talking path, made by looping together channels of the coaxial cable, was demonstrated to the Federal Communications Commission. Demonstrations were also made of television transmission over coaxial cable. By the end of 1945, the Bell System had some 2,000 miles of coaxial cable installed or in process of installation as far west as Dallas, and expects to reach Los Angeles in 1947, when this new transcontinental communications system will be available for either telephone or television transmission.

This revolutionary transmission system is based on the use of a coaxial conductor; two concentric cylinders of conducting material separated mainly by air. Such a structure may consist of two coaxial tubes, one over the other, or a copper wire surrounded by a cylinder of copper. The inner conductor is usually held in place and evenly spaced from the outer cylinder by insulating rings placed at regular intervals along the conductor, and since the volume occupied by these spacers is relatively small, most of the insulation between the conductors is air. Such a structure has the great advantage not only of giving low losses, but of almost completely eliminating electrical interference from the outside.

At high frequencies, the current in a conductor tends to travel only in a thin layer near the surface. With ordinary open-wire or cable pairs, therefore, the effective conducting cross-section is small, and the resistance high. With the coaxial structure, the current travels in the outer layer of the inner conductor and in the inner layer of the outer cylinder, but since the outer cylinder at least is larger than a cable or open-wire conductor, the conducting area available is larger. Since the dielectric path between the two conductors is chiefly dry air, the leakage and high frequency loss are very low and the same under all conditions. With open-wire pairs the leakage varies with weather conditions, and introduces a variable that is difficult to accommodate satisfactorily.

Probably the major advantage of the coaxial structure, however, is its freedom from outside interference. The outer surface of the outer cylinder acts as an electric shield that tends to exclude external electro-magnetic fields increasingly with frequency.

For use with coaxial structures capable of handling either television channels of several million cycles or a very large number of voice channels, complete carrier systems have already been developed. Because of freedom from interference, the currents may be allowed to fall to relatively low energy levels, approaching the limit set by resistance noise. Small repeaters at intervals of a few miles amplify as a whole the entire range of frequency. This revolutionary system not only solves problems raised by the need for wire television circuits, but facilitates the provision of large numbers of long-distance telephone circuits.



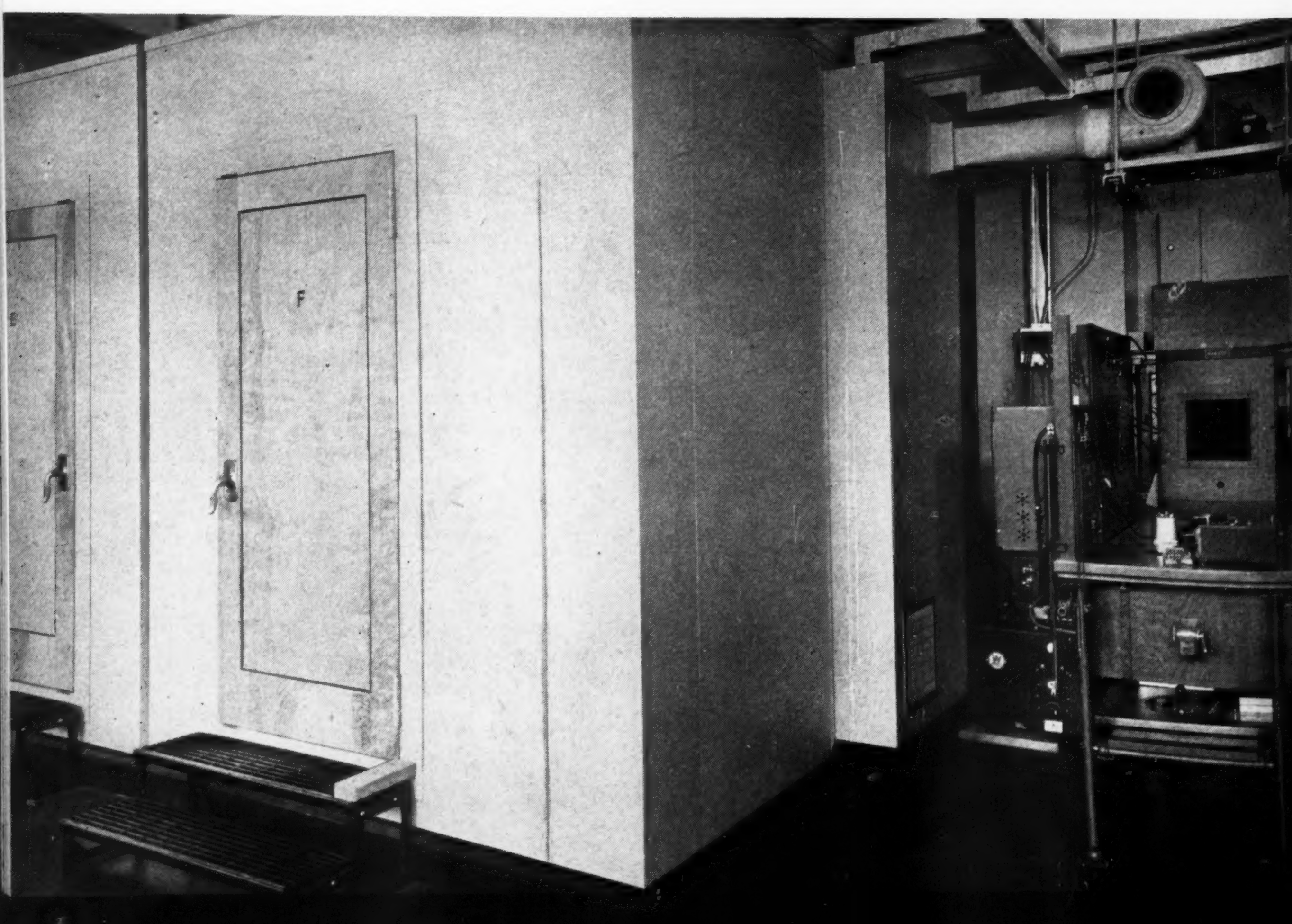
Demountable Soundproof Rooms

By W. S. GORTON
Physical Research

FOR reasons of acoustic efficiency and protection against fire, soundproof rooms have often been made of hollow tile plastered on both sides. These rooms are expensive to construct, noisy and dirty to dismantle, and have practically no salvage value. Where greater acoustic attenuation is desired, a double-walled construction is employed. For reasons of space economy, the separation of the two walls seldom exceeds six inches. This narrow air space makes it extremely difficult to avoid bridges between the walls caused by objects dropped into the interspace during construction. When this occurs, it vitiates almost completely the effect of the air space. The great weight has also made anti-vibration support difficult.

With the aim of overcoming these objections, a room was developed by the Laboratories which had panels made of two composite sheets of steel cemented to composition board with the interspace filled with rock wool. Their over-all thickness was three inches. A panel with ventilating duct attached was provided and the room was mounted on springs to reduce the effect of building vibrations. The attenuation of the room as constructed was limited by that of the door and the ventilation panel, but the results showed that this construction is inherently capable of giving substantially the same protection as a single hollow-tile wall. Figure 1 shows the acoustic attenuation of the panels plotted as a function of frequency. The steel panels weigh only 7 pounds per square foot, whereas a tile partition with ¾-in. plaster on both sides weighs 31 pounds per square foot.

When plans were made for the new lab-



oratory buildings at Murray Hill, it was decided to utilize steel panels for the soundproof rooms to be erected there. This construction had the additional advantage that it would harmonize with the partitions and other interior finish. The panel used, Figure 2, consists of two sheets of steel three inches apart with composition board cemented to their inner surfaces and a rock wool blanket between them. This construction obviates any mechanical coupling of the two components of the panel which might occur if the rock wool had been packed between them as in previous designs.

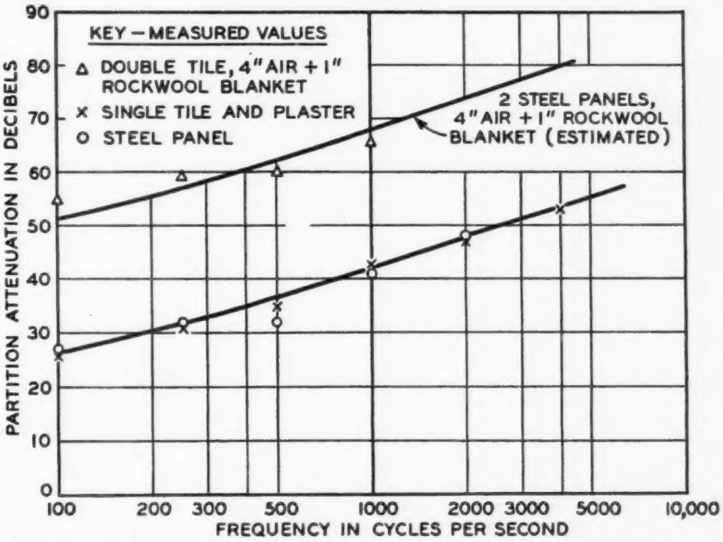


Fig. 1—Acoustic attenuation of the panels used in making the soundproof rooms at Murray Hill is practically the same as that of plastered tile

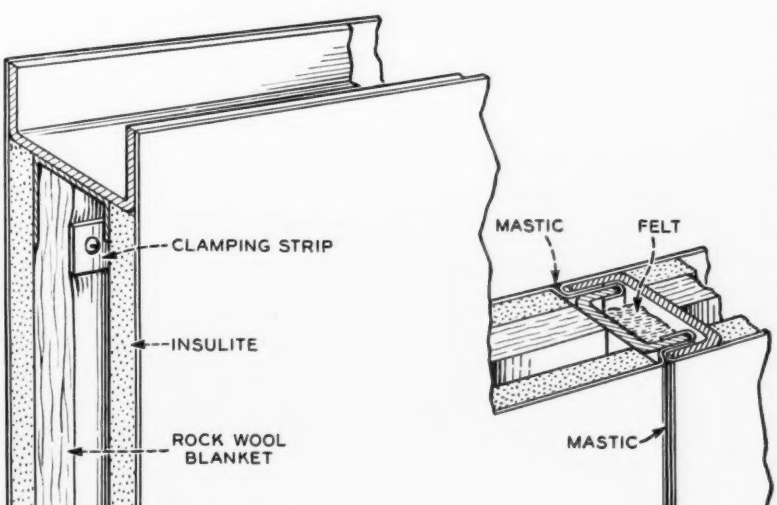


Fig. 2—The panels used to construct the soundproof rooms are made of two sheets of steel, three inches apart, with composition board cemented to their inner surfaces, and a rock wool blanket between them

The attenuation to be expected of the panel itself is consequently at least equal to that shown in Figure 1. This attenuation was attained for the room as a whole by careful attention to details, such as sealing all cracks with plastic compound, by using ventilating panels and doors of at least equal attenuation, and by supporting the room on rubber anti-vibration mountings.

The panels for the walls are chiefly of one size, 9 feet 2 inches by 3 feet 6 inches, with filler panels of half this width to completely close the sides of the room. Panels for floors and ceilings are of four standard sizes, and have lengths of 84 and 63 inches, and widths of 42 and 21 inches. The lengths of rooms obtainable with these panels are 7 feet or 10 feet 6 inches, with increases thereafter by increments of 1 foot 9 inches. The widths of the rooms

begin at 5 feet 3 inches, and increase by increments of 1 foot 9 inches.

Rubber-in-shear mountings completely support the rooms. Most of the weight is borne by installing them under the walls, but in all except the smallest rooms they are also placed under the floor beams. The mountings are located so that each one is deflected by the same amount irrespective of its location. To permit removing them conveniently if they should sag with time, the mountings are fastened to wood members in rows. Information on hand at the time of design, however, indicated that no appreciable sagging should occur. After three years there is no evidence of any in the rooms at Murray Hill. Each mounting was designed to deflect 0.3 inch under load. The natural frequency of the mounting thus loaded is about 5 cps.

Protection against objectionable acoustic resonances is obtained by placing three inches of sound insulation on the floor under the room and a two-inch rock wool blanket on top of the room. Essential constructional features are shown in Figure 3, where the room just described appears as the inner component of the double-walled structure described below.

The doors are made of wood. They are five inches thick, and have large, heavy, composite panels mounted in rubber. There are two panels, one on each side of the door, with an air space between them. The closure is made as air-tight as possible by double rubber gaskets and three-point hardware. The acoustic attenuation of these doors is about 43 db.

Ventilation panels, shown in Figure 4, are of labyrinthine design and lined with sound-absorbing sheet material. Their walls are similar to those of the structural panels and their attenuation is about 52 db.

Electric power and communication circuits enter through apertures near the edge of the ventilation panel. The space around the wires is sealed with mastic after their insertion. Outlets can be placed in any portion of the room in the standard duct used in the Murray Hill laboratories. This duct

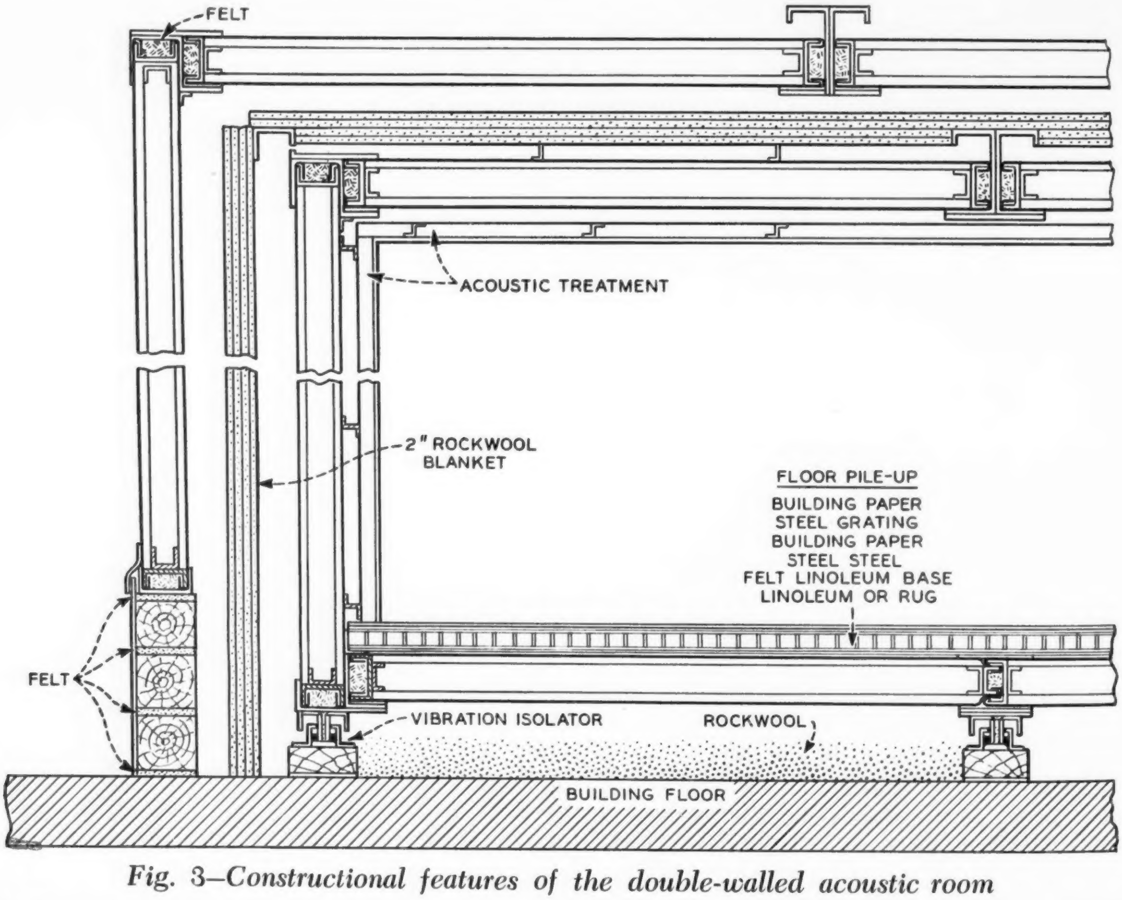


Fig. 3—Constructional features of the double-walled acoustic room

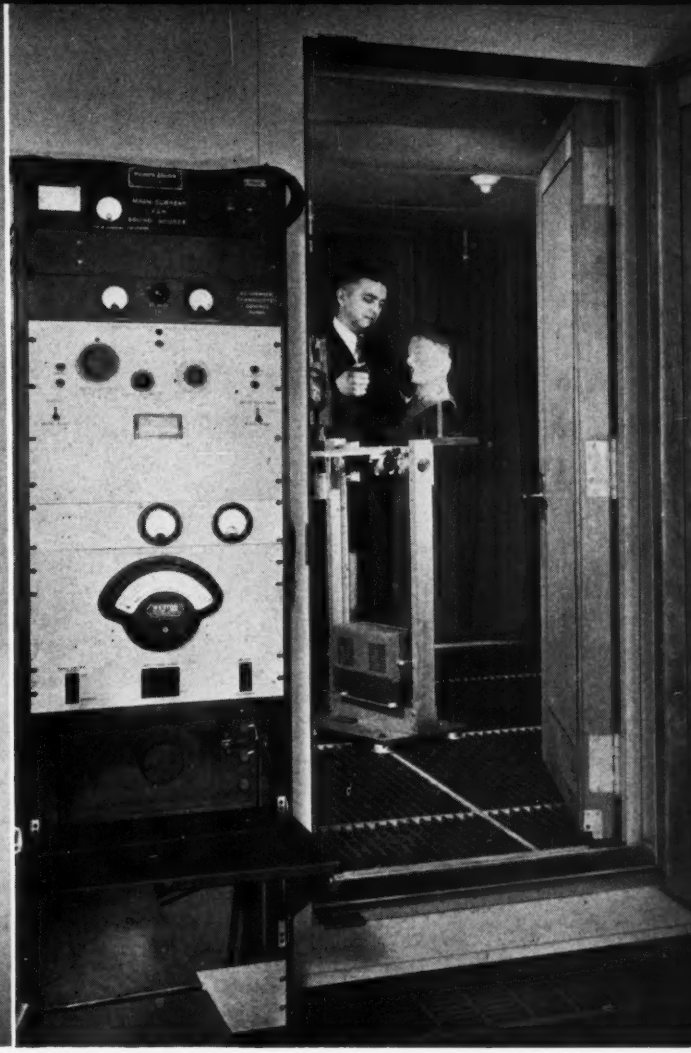


Fig. 4 (left)—Interior of a small single-walled acoustic room showing ventilating panels on the left wall. Fig. 5 (right)—Interior of a double-walled acoustic room. The duct for electrical wiring is attached to the outside of the panel behind the door

is attached to the surface of the panels and also houses wiring for the lights. Acoustic treatment has been installed in all of the rooms; examples can be seen in Figures 4 and 5.

For greater attenuation of sound, a room of the kind just described can be enclosed in another one built of the same or similar panels. For a moderate increase in attenuation, an extension of the panels of the enclosing room to the ceiling of the building room may suffice. This construction is effective against noise originating on the same floor, but not against that from the floor above. For the largest feasible increase in attenuation, the enclosing room has a separate ceiling of the same standard panels used for the floor and ceiling of the inner room. Since the panels are standard, the length and width of the outer room exceed those of the inner one by 1 foot 9 inches. This provides an air space 7.5 inches wide. The floor of the outer room is the floor of the building, because it was decided after careful consideration that there would probably be little benefit from trying to provide the outer room with a floor of steel panels, and that in any event the possible benefit of such construction would be far outweighed by the increased expense and bulk. The extra height necessary to permit using the same wall panels for both the inner and outer rooms is obtained by putting the walls of the outer room on a laminar structure of timbers separated by hair felt. The pile-up is twelve inches high and it is covered with steel sheathing for appearance. A similar sheathing is provided to enclose the space under a single-walled room. An apron, which extends over the gap between this sheathing and the room, effectively retards the en-

trance of dirt and dust into the space underneath the structure.

Single-frequency attenuation measurements have not been made in these rooms owing to the pressure of war work, but noise meter measurements show an attenuation of forty-three db for the single room and at least fifty-seven for the double room. Their construction and demounting involve little dirt and noise, and there is practically complete salvage of the material, as has been demonstrated by experience. Eighteen rooms have been installed at Murray Hill.

The design of the rooms was carried out under the direction of the Laboratory Equipment and Services Committee of the Laboratories of which the author was chairman. It was based on that of the predecessor room mentioned in the second paragraph of this article. The counsel and advice of all members of the Laboratories experienced in this field was solicited, and suggestions were received from many persons. The rooms consequently represent the work of many individuals and are a good example of coöperative enterprise.

THE AUTHOR: W. S. GORTON received the A.B. degree from Johns Hopkins University in 1908, the A.M. in 1910 and the Ph.D. in 1914. He was instructor in Electrical Engineering at the Massachusetts Institute of Technology from 1911 to 1913; physicist with the Brady Urological Institute of Johns Hopkins Hospital from 1914 to 1917; and associate physicist at the Bureau of Standards from 1917 to 1919. In 1919 he joined the Laboratories, where he has since been engaged in problems relating to voice-operated telephone repeaters; the development and manufacture of submarine telegraph and telephone cables; and the properties of base metal telephone contacts as affected by mechanical vibration. In 1939 he became executive assistant to the Physical Research Director. During the war he was also Technical Aide and Special Assistant to the Chief of Section 17.3 of the National Defense Research Committee.

Television Via Coaxial From Washington to New York

THE Bell System's new coaxial cable link between Washington and New York was used for long-distance television for the first time February 12 when Lincoln Memorial ceremonies were televised in the Nation's capital and carried to television stations in New York. This represents a pioneer step toward Bell System television networks that ultimately will add sight to the sound of broadcasts nation-wide.

The telecast featured the placing of a wreath at the base of the former president's statue by General of the Army Dwight D. Eisenhower. Others who were televised included Washington congressional leaders.

Also presented in the program was a description of how coaxial cable is used in transmitting television and a detailed chart of the Washington-New York link together with a general map of the Bell System's nation-wide coaxial cable routes.

The program was planned jointly by the television staffs of the National Broadcasting Company, the Allen B. DuMont Laboratories, and the Columbia Broadcasting System. Using the coaxial cable, the telecast was relayed to New York and seen and heard there through the facilities of NBC's television station WNBT and DuMont's television station WABD. In Washington the program was carried by DuMont's television station W3XWT.

Each of the three broadcasting companies have the use of the New York-Washington cable two nights a week for experimental purposes. For the present, the direction of transmission is from Washington to New York.

An Electro-Mechanical Page Turner

ANNOUNCEMENT of a page-turning machine designed by R. F. Mallina of the Laboratories has brought new hope to thousands of people disabled by wounds or paralysis who cannot now entertain themselves without constant assistance from others.

Created originally to help a paralyzed veteran at Halloran Hospital who liked to read but could not turn the pages, the page turner has been greeted by such a storm of requests from disabled people and institutions caring for them that it will soon be produced in quantity. The first quotas of sets from the production line, it has been announced, will go to disabled veterans.

Mr. Mallina became interested in building such a device through a neighbor connected with the Red Cross and who was concerned about the veteran at Halloran.

"Can you make a push-button controlled device which turns the pages of a book?" the neighbor asked.

Mallina's first reaction was that the job should be easy and that he could provide a suitable device within a week or so. But it was more difficult than he had anticipated.

"I discovered," he says, "that the five fingers of a hand can do a lot more than mechanical and electrical elements. A vac-

Mrs. Drayton Cochran, Red Cross Grey Lady, tightens the adjustable neck-cord so that V. W. Bennett, one of Mallina's assistants, can operate the switch by pressing with his chin

uum cup, for example, due to the fact that paper is porous, picks up more than one page at a time. A rubber tip moved along the plane of the paper and separating the pages by friction also has a tendency to turn over more than one page at a time. I tried many variations along these lines and they all failed."

After two months of patient analysis and experimentation, an amazingly simple and effective solution occurred to him. The device uses a thread to which very thin metal paper clips are tied by a series of knots at intervals of about a foot. One end of the thread is attached to a motor-driven rotating drum and the clips, in their order on the thread, are slipped onto the edges of successive pages of the book. The drum is mounted on the left-hand side of a tray to which the

V. W. Bennett demonstrates how a man flat on his back can read a book on the page turner through a mirror arrangement. Mrs. Drayton Cochran places the book in position

book is clamped, and as the drum turns, it winds up the thread, pulling the clips and the pages to which they are fastened one at a time from right to left. When the page has turned, its clip slips off very easily and winds up with the thread on the drum. Winding is continued until the thread pulls taut so that it will hold down the left-hand pages. A transparent plate, hinged to the right side of the tray and resting against the pages on that side, keeps them from turning until they are pulled by the thread and clip arrangement.

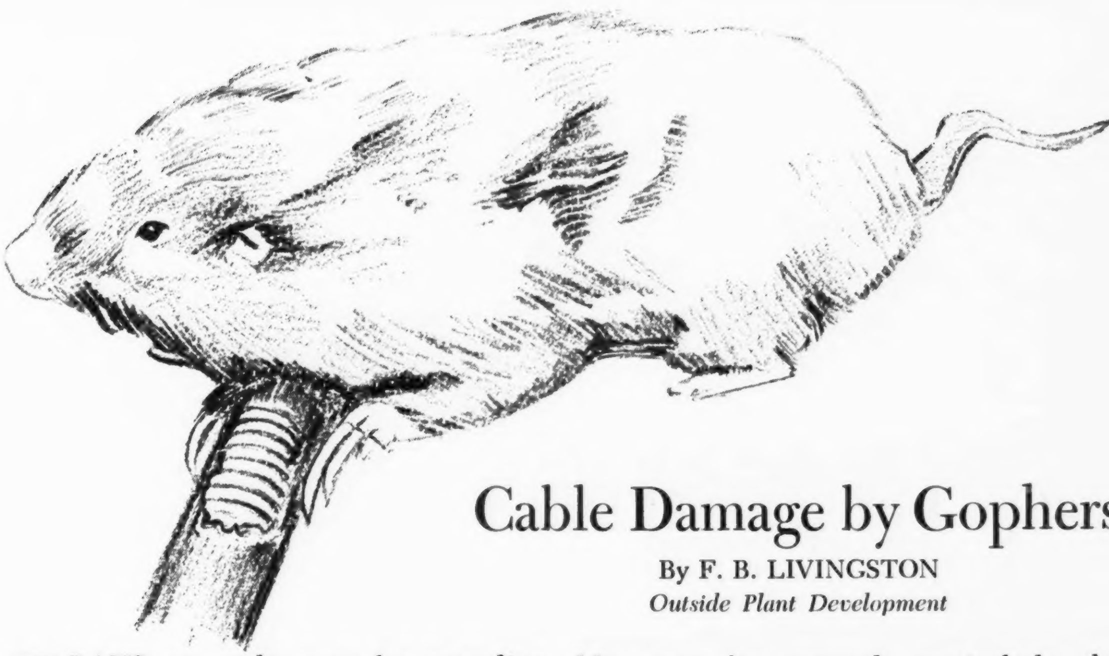
The device can be plugged into a normal household electrical outlet, and the "flea-power" motor is controlled by a feather-touch switch hung around the neck of the patient, who is able to operate it by lowering his chin.

A special adaptation of the page turner has been devised for iron lung cases where the patient must lie flat on his back with only his head and neck outside the lung. The tray is placed beyond his head in a line with his body, and he reads the book through an arrangement of two mirrors suspended on a bracket above him. The patient then operates the page turner by moving his head against a switch.

The present arrangement of the apparatus is such that the reader must depress the switch as long as the page is turning. A mechanism could be arranged so that a short closure of the switch would perform the complete cycle of turning a page. However, it has been observed that patients who have been deprived of many natural muscular functions enjoy exercising the skill that is necessary in timing the motor.

General Textile Mills, Inc., has begun to build the page turner in quantity, and inquiries regarding it should be directed either to them at 450 Seventh Avenue, New York 1, N. Y., or to the Camp and Hospital Committee of the American Red Cross, New York Chapter, 401 Fifth Avenue, New York 16, N. Y. The Red Cross reports that the Army Surgeon-General's office and comparable authorities in the Navy are at present trying to determine how many will be necessary to take care of disabled veterans, and these quotas will be filled next. It is anticipated that page turners will be available eventually to all who need them.

The inventor, R. F. Mallina, in the act of turning a page with his machine. The page turner may be used with either books or magazines



Cable Damage by Gophers

By F. B. LIVINGSTON
Outside Plant Development

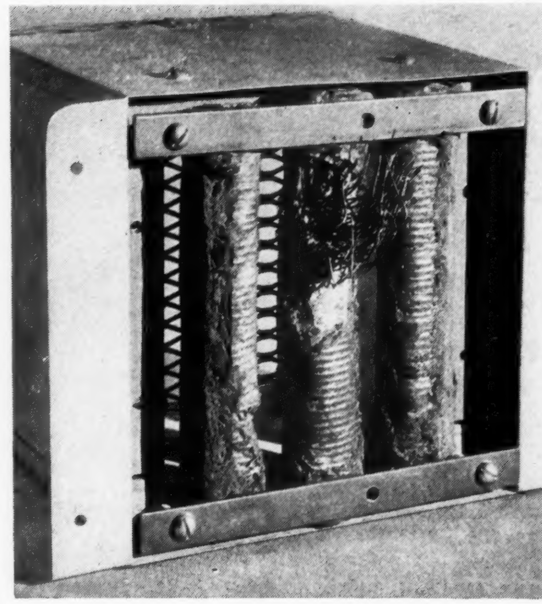
PLANS are under way for extending the coaxial cable system to the West Coast, and most of this new construction will be plowed under ground. In some of the territory west of the Mississippi, gophers abound and their sharp teeth are able to gnaw through the jute and lead cable coverings which provide adequate protection in most other parts of the country. Only within the last few years have cables been buried in gopher-infested soil and the data which have been obtained on the depredations of these rodents have come by the hard way of experience in the field.

To protect buried cable against this hazard, thin steel tapes were wrapped over the sheath at the factory and an outer covering of impregnated jute or low grade rubber sheeting was added to prevent the steel from corroding. The first toll cable thus protected was placed between Stevens Point and Minneapolis in 1940. No reports of gophers penetrating its steel tape have been received but they riddled the corrosion protection in a section between Grand Island and North Platte, Nebraska. Electrical tests and exploratory inspections showed that the outer covering of this cable had been stripped, in a fifteen-mile section, at as many as 2,500 places ranging in length from a few inches to several feet, thus exposing the thin steel to rusting and further gopher attack.

Another hazard to which buried toll cables may be exposed, particularly the smaller cables, is that of damage by lightning. Increasing the conductivity of the lightning path by adding a copper wrapping over the lead sheath is one method of protecting these cables. Since lightning storms often occur in gopher territory, and since thin copper might give adequate lightning protection, it was thought desirable to try to find out whether the copper could be depended on for the dual rôle of protector from both lightning and gophers.

To obtain data on the power behind a gopher's teeth, pieces of experimental cables which had several kinds of mechanical protection over the lead sheath were buried a few years ago in rodent-infested territory near Denver, Colorado. To supplement this study, it was suggested at that time that a quicker answer might be obtained if live gophers could be kept in captivity and induced to gnaw on cable samples. This undertaking, a novel one for the Laboratories, required discussions with the staff of the Bronx Zoo on the care and feeding of gophers in captivity. A request for gophers was made to the Northwestern Bell Telephone Company, which in turn enlisted the aid of the Iowa State Agricultural Department.

Gophers are not very sociable animals, and where two are placed together in a confined space they usually fight until one or both are dead. Those used in the experi-

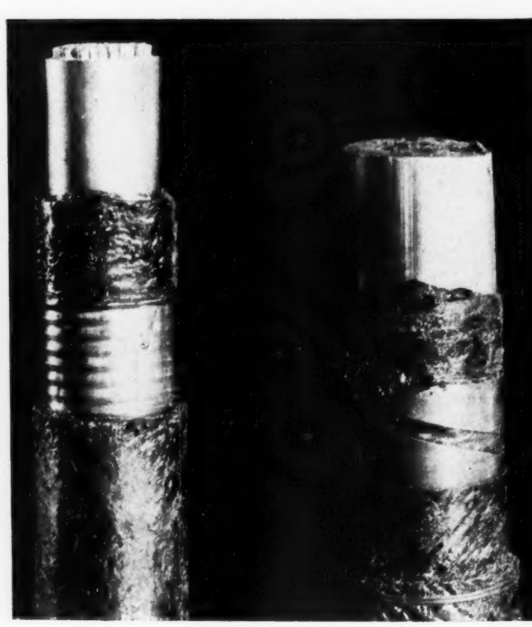


Left—To determine the ability of gophers to gnaw through cable sheath, samples were placed over holes in the bottoms of ash cans in which the rodents were confined

Above—A sheet iron sample holder was bolted over the hole in the bottom of the gopher cans

Lower left—The gopher has teeth designed for gnawing and claws with which to dig

Below—Experimental cable with copper tape (left), and standard cable protected by steel tape (right)



ment were, therefore, shipped singly in ash cans which contained some food and also dirt in which they could burrow. An earlier consignment, whose prospective duties had not been fully understood by the agent who obtained them, arrived carefully packed in dry ice.

Typical damage by gophers to cable protected by copper tape five mils thick

Since the gopher is a burrowing animal and spends most of his time underground, it was thought that he would be more apt to attack cable samples if they blocked an opening in the floor of the pen, with dirt on the far side of the samples to offer apparent escape. The ash cans provided convenient pens, so holes about six inches square were cut in their bottoms and cubical sheet iron containers in which the samples could be mounted were bolted over the openings. Earth in which they could burrow was placed in the cans.

They were kept in these cans in the basement of one of the buildings at the Chester field laboratory. Once a week they were transferred to other cans and the cable samples were examined and photographed. Fresh earth was then put into the original cans, after which the gophers were returned to them. Disturbing the rodents oftener than about once a week decreased the amount of their gnawing.

Some of them began to strip the outer covering from the cable samples almost immediately and in a few weeks they had severely damaged the sheath of those not protected by steel or copper tape. During the early part of the test, however, while the samples barred the exits in the bottom of the pens, none of them penetrated the copper tape.

To find out whether the jute was removed by the gophers in an effort to get out of the cans or just as a pastime, cable samples were stuck loosely in the dirt of the cans. In some cases, these loose samples were attacked initially more than those in the bottom of the can. On none of the loose samples, however, was the copper much damaged even after an average exposure time of nine weeks.

As the animals became tamer they spent more time on top of the ground instead of burrowing out of sight immediately when placed on fresh earth. This suggested that there might be more incentive to gnaw the samples if there were light beyond the apparent exit. To explore this possibility, the cans were laid on their sides so that the cable samples barred an end of the pens instead of a bottom exit. This arrangement was found to be more conducive to effective work and all of the gophers managed to gnaw through the five-mil copper tape and on through the lead beneath. One gopher ruined samples within one

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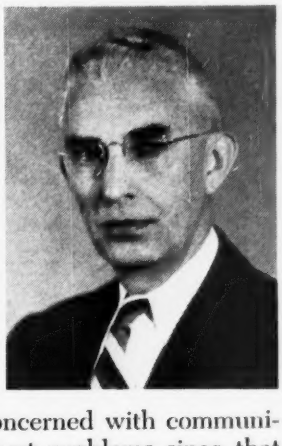


THE AUTHOR: F. B. LIVINGSTON was graduated with the B.S. degree in electrical engineering from Kansas State College in 1912 and received the E.E. degree there in 1933. He joined the student course of the Western Electric Company at Hawthorne on completion of his undergraduate work and was then assigned to the lead-covered cable development group. Mr. Livingston has been concerned with communication cable development problems since that time, one of which was the protection of cable against inquisitive gophers.

week, but the average time was three weeks. The slowest required seven weeks. Seven- and ten-mil copper were also tried. The final score showed that, under conditions which might be considered normal or moderately severe, that is, when the samples barred the bottom exits or were loose in the soil, none of the gophers seriously damaged the five-mil tape. Under the more severe test of samples barring side exits, all the gophers were able to ruin cables protected by five-mil tape but only one was able to damage ten-mil tape.

Based on this work, ten-mil copper tape was judged to be a reasonable risk and it is being used as combination lightning and gopher protection on the Dallas-Los Angeles coaxial cable now in production.

Frank B. Jewett Fellowships

AWARD of five Frank B. Jewett Fellowships for research in the physical sciences was recently announced by the American Telephone and Telegraph Company which founded the grants two years ago upon the retirement of Dr. Jewett. The recipients are Dr. Martin G. Ettlinger, Dr. Edward W. Fager, Dr. Bernard Goodman, Dr. Shuichi Kusaka, and Dr. Robert L. Scott. Three are chemists and the other two are physicists.

Purpose of the fellowships is to stimulate and assist research in the fundamental physical sciences and particularly to provide the holders with opportunities for individual growth and development as creative scientists. The awards carry an annual stipend of $3,000 to the holder and $1,500 to the institution at which the recipient elects to do research.

Dr. Ettlinger, of Austin, Texas, has just received his doctorate in chemistry from Harvard University. He received his bachelor's degree from the University of Texas in 1942 and his master's from the same university in 1943. He plans to investigate the chemistry of cyclopropane, cyclopropene and dicyclobutane derivatives.

Dr. Fager, of New York City, has been working with Manhattan Project. A chemist, he received his bachelor's degree from Yale in 1939 and his doctorate from the same university in 1942. He will study photosynthesis in green plants.

Dr. Goodman, of Philadelphia, has been engaged in war work at the University of Pennsylvania, where he is associated with the Randall Morgan Laboratory of Physics. He received his bachelor's degree from that university in 1943 and his doctorate in 1946. He will study very high energy particles and processes.

Dr. Kusaka, a resident of Northampton, Mass., where he was an instructor in physics at Smith College before enlisting in the Army, received his bachelor's degree at the University of British Columbia in 1937, his master's at the Massachusetts Institute of Technology in 1938 and his doctorate at the University of California in 1942, after which he was associated with the Institute for Advanced Study at Princeton. A theoretical physicist, Dr. Kusaka is in the Army of the United States, stationed at Wright Field.

Dr. Scott, of Santa Ana, Cal., has been associated with Manhattan Project. He received his bachelor's degree from Harvard in 1942, his master's from Princeton in 1944 and his doctorate, also from Princeton, in 1945. A chemist, he will study the thermodynamics of solutions.

The fellowships are awarded on the recommendation of the Frank B. Jewett Fellowship Committee, consisting of seven members of the scientific staff of Bell Telephone Laboratories who are actively and creatively engaged in research in physics, mathematics and chemistry. Primary criteria are demonstrated research ability of the applicant and the fundamental importance of the problem he proposes to attack and the likelihood of his growth as a scientist. The awards are post-doctorate and only scientists who have recently received their doctorates or who are about to receive them are normally considered.

What We Think About Held Orders

By ARTHUR W. PAGE
Vice-President, A T & T Co.

Facing a test of its mettle hardly second to that posed by the war, the Bell System tackles the 2,000,000 applications for telephone service that have not yet been filled due to wartime shortages. Vice-President Page's vigorous words are an inspiration to all Bell System people.

HELD orders are not just statistics on a sheet. They represent people and people we will be living with for the rest of our lives. They have been exceedingly tolerant. That has been one of the most impressive facts of the war time. But what happens when they cease to be tolerant and how fast it happens are equally as impressive. In one place in the Bell System complaints rose 1,000 per cent in three months.

If people really believe that we are doing everything that can be done, I think they will still be friends of ours, for a while. But the second they suspect that we are taking their inconvenience easy, or letting their suffering save us some trouble, or money, there will be trouble for us aplenty.

This business has lived and grown successful and of good repute by giving service. It has given the public what it wanted when it wanted it, and done it with efficiency and courtesy—and then invented better things and taught the public to want them and ask for them.

That is what made this business something more than just a business. It made it a good place to work, a good life to live, something with a little distinction.

It did its best to serve the public. That paid off when it was comparatively easy to do.

Well, now it is hard—what about it? What do we do? Shall we run the business for our convenience? Shall we run it to meet some long distance "prove in" rules? Shall we serve our engineering studies? Or shall we serve the public?

What is the objective? To give people the best possible service as cheaply as we could do it. But the "service" comes before the "cheap." And not just to serve those we found it convenient to serve.

Our job is to serve every single person that we possibly can and get service to them as fast as we can. That may mean putting plant in and taking it out again in a little while.

What did we do after the hurricane? Did we wait until we had everything engineered for the year 1960? We did not. We got something going fast and improved it afterward.

Well, this is just like the hurricane, but a whole lot worse. What did we expect—to have the worst war in history and have it result in the millennium of ease and comfort? The phrase "the war is over" is a hallucination as far as we are concerned. The war has just got to our front. This is our big time, and if we are not going to throw away all the ideals of our history we are going to take off our coats and show the world what we can do in a fight.

Are we going to degrade service a bit for the many to give service to a few more? Sure we are. We are going to give everyone some service just as fast as it can be done and we are going to tell everyone exactly what we are doing. It is the only just thing to do, and the public relations of this business are not as good as we think they are if we can't manage to live with the truth and justice no matter how unpleasant the truth is.

This is no time for little faith, or half-way measures. It is time to strain every effort to give service, and a time for full explanation of what the facts are.

It is a time to increase our reputation by the energy and ingenuity with which we meet our difficulties and the complete sin-

cerity of our efforts—and the complete frankness with which we tell the facts.

If this Company has done everything humanly possible to give service we think we can say so in a way to keep our friends as well as our self-respect.

But if, because some people must wait some, we have let down and let more wait than need be, and wait longer than they had to, there is no way to make a good story of that. We won't believe it ourselves and we can't make anyone else believe it.

No one is asking us to save the last nickel. Take a vote. Ask the public, do you want telephones now or a little saving later and a perfect engineering record?

Maybe we don't face those questions in those words. But we do face those questions. And I have no doubt what the answers are.

The question is how good a job do we do. How much of lasting satisfaction do we get out of recognizing the biggest and hardest job we ever had and licking it.

If we see it for what it is we'll lick it, and like licking it.

G. C. Southworth Awarded Levy Medal by Franklin Institute

Franklin Institute honors G. C. Southworth

G. C. Southworth has been awarded the 1946 Levy Medal of The Franklin Institute for his discovery that the sun gives off short wave radiation, similar to that employed in radar. This discovery, according to Dr. Henry Butler Allen, secretary and director of the Institute, opens the way to an entirely new field of research which, it is hoped, will yield considerable additional information on the earth's atmosphere, as well as the sun itself.

The medal, one of the highest awards in the field of science, has been given annually since 1924 to the author of a paper of especial merit published in the *Journal of The Franklin Institute,* preference being given to one describing the author's experimental and theoretical researches in a subject of fundamental importance. Dr. Southworth announced his discovery in a technical paper, *Microwave Radiation from the Sun,* which was published in the April, 1945, issue of the Institute's *Journal.*

A conspicuous part of Dr. Southworth's investigation of this problem began some fifteen years ago when he conducted experiments in which extremely short waves, similar to radio waves, were guided through the interior of hollow metal pipes.

Subsequent developments, largely by Dr. Southworth and his associates, led to a novel yet practicable means of handling such waves. This method of dealing with these very short waves has come to be known as the waveguide technique. It has been used extensively in radar applications and plays an important part in the proposed intercity radio relay systems for television and other communications.

Dr. Southworth was born near Little Cooley, Pa., in 1890, and received his doctorate from Yale in 1923 after graduation from Grove City College. He was an instructor and assistant professor of physics at Yale before he became associated with the Bell System in communications research in 1923.

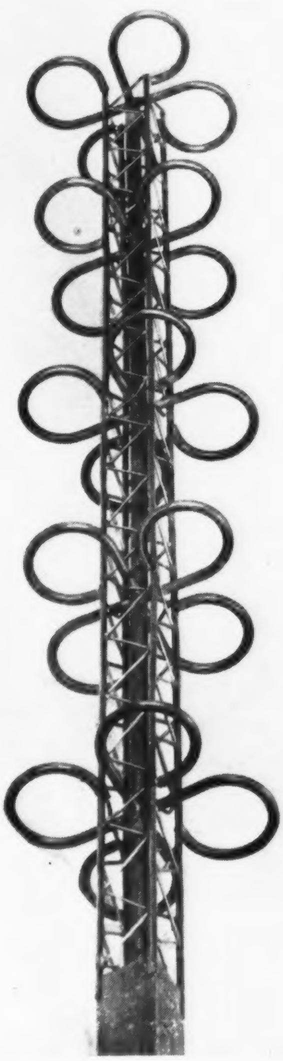
Dr. Southworth is a fellow of the American Physical Society, of the American Association for the Advancement of Science, and of the Institute of Radio Engineers. In 1931 he received the honorary degree of Doctor of Science from Grove City College, and in 1938 he was awarded the Morris Liebman prize of the I.R.E.

The Levy Medal will be presented to Dr. Southworth by Charles S. Redding, president of The Franklin Institute, on April 17 at the annual Medal Day ceremonies of the Institute in Philadelphia.

"Cloverleaf" Antenna for FM Broadcasters

A NEW high efficiency antenna to meet the FM Broadcaster's needs for maximum coverage of a given area has been announced by the Western Electric Company. The new antenna, called the 54A antenna, or "Cloverleaf," was designed by the Laboratories to radiate horizontally polarized waves and to concentrate this radiated energy into a service area surrounding the transmitting station. The new antenna is engineered particularly for use by frequency modulation broadcast stations operating at the new FCC assigned carrier frequencies between 88 and 108 megacycles and at power levels up to and including 50 kilowatts. The electrical design of this antenna was done by P. H. Smith and the mechanical design by E. H. Karleen.

The 54A antenna comprises an array of two or more vertically stacked radiating units with each radiating unit composed of a cluster of four elements, which in plan view forms a symmetrical shape similar to a four-leaf clover. A radio-frequency voltage applied between the junction of the four elements and their ends causes in effect a ring of uniform current which produces a circular radiation pattern about the axis of the ring. By utilizing the directive properties of a vertical stack of such radiating units, much of the energy which would otherwise be radiated into outer space and thus lost for any useful purpose is diverted so as to increase the energy being transmitted into the station's service area. This conservation of the radiated energy permits the establishment of the station's required signal strength with radio transmitter powers of only one-fifth to one-half the amount otherwise needed. This reduction in the required transmitter power output is usually referred to conversely in the statement that the antenna has a power gain ranging from about two to about five, depending on the size of the antenna (number of radiating units) that is selected.



Maximum antenna gain occurs when the instantaneous currents in all radiating elements are in time phase and of equal amplitude. In the 54A antenna these important relationships are easily and correctly established at the station's operating frequency at the time of installation by methods which do not require field or factory tuning. All radiating units are connected by means of simple clamps at half-wavelength intervals to a 3-inch diameter feed conductor which is centrally located within the tower structure. The tower itself serves as the return or outer conductor of the feed line. The usual phase reversal occurring along such a feed line at half-wavelength intervals is compensated for by merely reversing the mounting position of the radiating elements in adjacent units. Thus, by this simple installation procedure, the correct current phasing for maximum gain at the station's operating frequency is assured.

The design features of the antenna make possible the elimination of such

items as multiple transmission lines, phase correcting lines or networks, balancing lines, etc., which in present antennas prove troublesome because their length must be adjusted for the operating frequency to avoid errors in antenna current relations with a corresponding compromise in antenna gain.

The tower furnished as part of the 54A antenna is one foot square and composed of an assembly of standardized structural steel welded sections. Its principal components consist of a base section and from one to four uniform lengths, depending on the antenna size selected.

Royalty-Free License for Making Power-Line Carrier Apparatus

Bell System patents to make equipment developed by the Laboratories for sending telephone conversations over rural electric power lines have been offered to manufacturers of telephone equipment in this country by the American Telephone and Telegraph Company.

In a letter to W. C. Henry, President of the United States Independent Telephone Association, announcing this, Keith S. McHugh, Vice-President of A T & T, also stated that "at the same time we shall be prepared to extend to manufacturers in this country a royalty-free license to make such power-line carrier apparatus in so far as Bell System patents are involved and to sell it for use in the United States for the purpose of extending telephone service directly from a central office of a telephone company to the premises of its rural customers, including service line customers."

Microwave Radio System Between Nantucket and Cape Cod

To fill Nantucket Island's need for additional long-distance telephone facilities, the New England Telephone and Telegraph Company plans to install next summer a microwave radio system providing eight circuits between terminals on the island and on Cape Cod. The new circuits will increase Nantucket's total to twenty, as twelve circuits are now operated through the submarine cable which first carried long-distance service to the island almost thirty years ago.

The system planned is basically of a type developed by the Laboratories for war use, known to the Army and Navy as AN/TRC-6, which operates on a frequency of nearly 5,000 megacycles. The Nantucket installation and another like it planned for about the same time for Catalina Island off the California coast will be the first units of their kind to become integral parts of the Bell System's long-distance network of wire and radio circuits.

To obtain an unobstructed line-of-sight path between antennas for the Nantucket-Cape Cod installation, the two antennas, which will be about thirty miles apart at locations on the island and on the cape, must be high enough to allow the beam to clear the intervening curvature of the earth. This height will be reached by mounting the antennas on towers to be erected on

SUGGESTIONS

The Laboratories has always welcomed original suggestions from its employees on any matters relating to the Company's activities or interests, both technical and non-technical. The normal channels for making suggestions are through supervision or, if preferred by the originator, directly to an appropriate Laboratories executive. On occasion an employee may want a less formal channel. To provide for this, Morton Sultzer has been designated "Suggestion Consultant." In this capacity he will insure direct and confidential treatment of suggestions whenever desired. Any member of the Laboratories desiring to submit a suggestion, either written or oral, through this less formal channel may make direct contact with Mr. Sultzer, who will see personally that such suggestions are given appropriate consideration and will report the result to the originator of the suggestions.

This plan does not contemplate any change in the personnel advisory functions in the Laboratories. As in the past, an employee who seeks personal advice as to his Company relationships should ordinarily make direct contact with any supervisor or executive in the line of his supervision; or, if he prefers, he may select any member of the Personnel Department for such advice.

the highest natural elevations obtainable. Each tower will have two of the bowl-shaped antennas—one for sending and the other for receiving.

The Nantucket tower will be placed on a hill near the junction of Madaket, Eel Point and Upper Cliff roads, about two and a quarter miles west of town. On Cape Cod the tower will be placed on the southerly slope of Clay Hill in the western part of Barnstable near the Barnstable-Falmouth County road. At each location a small building will also be erected to house the radio equipment. The Nantucket tower will be connected to the local telephone central office by cable, and the one in Barnstable will be similarly connected to the central office in Hyannis.

Norman A. Sorger
1923-1946

Lieut. Gerard E. Davis
1923-1945

Two Gold Stars Added to Laboratories Service Flags

The Laboratories regrets to announce the deaths of two members in military service, Lieut. Gerard E. Davis, who was killed in a crash in India on April 11, 1945, and Pfc. Norman A. Sorger, who died aboard ship while en route home from Japan, after 21 months of overseas duty.

Lieut. Davis was killed on April 11, 1945, in a plane crash over Assam, India, and is buried in the Panitola Military Cemetery in India. He joined the Laboratories as a messenger on June 24, 1941, and in September of the following year was promoted to Junior Mechanic in the Development Shop Department. His military leave was granted on January 29, 1943, and he was assigned to the Air Corps as an aviation cadet at San Antonio, Texas. From there he took advanced training in P-40's and in May, 1944, was commissioned a second lieutenant. Lieut. Davis was attached to a fighter squadron in the Assam Valley and was presumably flying a P-51 when killed.

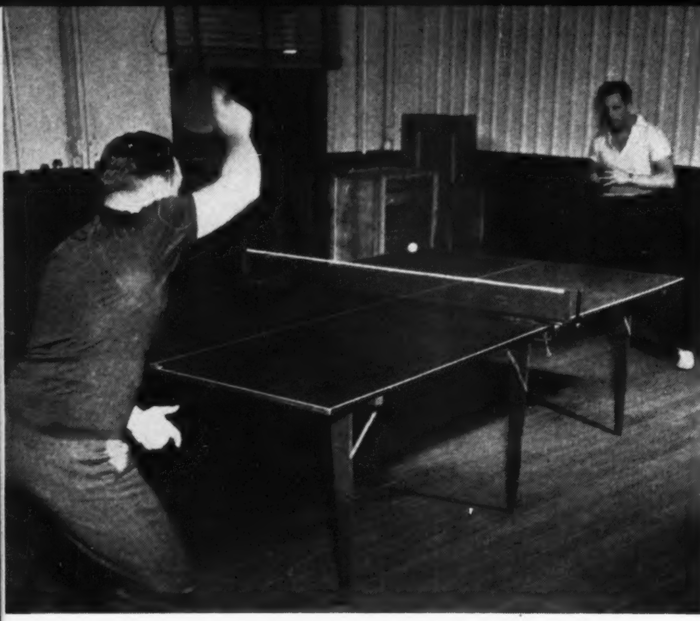
Pfc. Sorger, a drafting assistant in the Equipment Development Department, died on February 18 aboard the U.S.S. *Mormacwave* en route to San Francisco from Japan. A member of the 390th Infantry, 98th Division, he had studied at Bowdoin College under the ASTV program and trained at Camp Rucker before being stationed at Pearl Harbor and subsequently at Osaka.

Upon graduation from Cranford High School in 1941, Pfc. Sorger entered the Equipment Development Drafting Department and worked there until he was granted a military leave on April 1, 1943. Of thirty-four months of military service, he had spent twenty-one overseas.

Dr. Llewellyn Addresses Electrical Engineers in England

F. B. Llewellyn, as representative of the Institute of Radio Engineers of which he is president, flew to England to address a special radar convention, held from March 26 to 28, of that country's Institution of Electrical Engineers. His address before the British group reviewed in some detail the very fruitful coöperation between British and American research workers in perfecting radar equipment during the war, a project in which Dr. Llewellyn was active.

Dr. Percy Dunsheath, president of the British group, and W. K. Brasher, its secretary, were guests at the recent New York meeting of the I.R.E. and Dr. Llewellyn's visit is expected to cement further the extensive coöperation between scientists of the two nations.



In the Men's Spring Table Tennis Tournament at the Whippany Laboratory, the winner was H. C. James, left, and the runner-up, F. W. Kausch, right. Scores 16-21, 17-21, 21-19, 21-15, *and* 21-19

Col. C. H. Greenall to Join Franklin Institute Laboratories

In a recently announced reorganization of the Franklin Institute Laboratories, Lieut. Col. Charles H. Greenall will become its executive director reporting to Dr. Henry Butler Allen, secretary and director of the Institute. At present, Col. Greenall, who is on a military leave of absence from Bell Laboratories, is Officer in Charge, Laboratory Division, Ordnance Department, Frankford Arsenal.

Col. Greenall joined the Laboratories in 1922 after graduating from Lehigh University with an M.E. degree. His first work was on apparatus analysis and protection. In 1927 he transferred to the materials group where he engaged in the development of specifications for non-ferrous materials and in the design of equipment and application of methods for fatigue tests on these materials. From 1931 until he went to Frankford Arsenal in 1942 he was in charge of the metallic materials and materials testing group.

Bell System Companies Awarded Navy Certificate

In recognition of the wartime accomplishments of Bell System men and women and their contribution to the national war effort, the System has been awarded a Certificate of Achievement by the United States Navy. Presentation of the Certificate was made February 20 by Commander W. J. Warburton, representing the Secretary of the Navy, to Walter S. Gifford, President of A T & T, who accepted it in behalf of the Bell System companies.

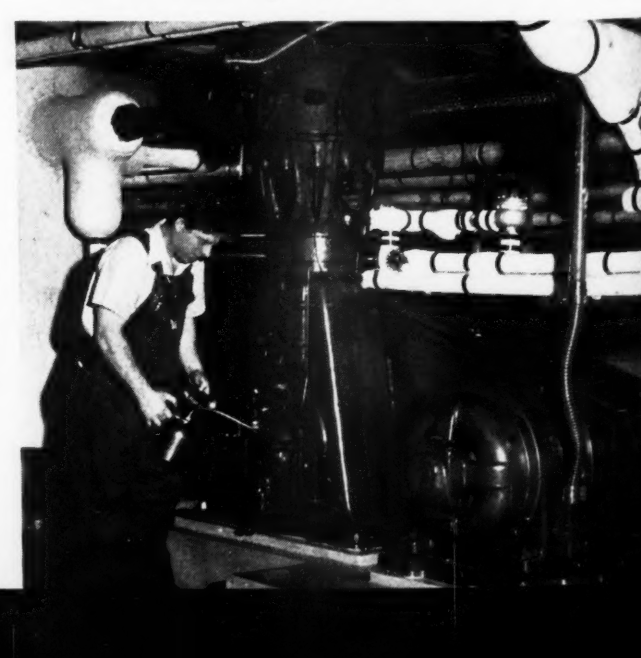
The Certificate bears the embossed seal of the Navy and the inscription: "Awarded to American Telephone and Telegraph Company and Associated Bell Telephone Companies in recognition of exceptional accomplishment in behalf of the United States Navy and meritorious contribution to the national war effort."

Second Bell System Radio Course for Engineers

The second school for Associated Company engineers charged with responsibilities connected with the planning, engineering, and operation of radio-telephone systems for urban and highway vehicular service completed its six weeks' session at the Davis Building on February 15.

At the outset, lectures and problems on wire transmission, radio concepts, methods of modulation, fundamentals of frequency modulation, theory of radio propagation, noise, and interference served as an introduction and a rapid review. In the lectures, demonstrations, experiments and in-

For some vulcanizing operations in the rubber laboratory at Murray Hill and for plastic molding, hotter steam is required than is supplied by the Laboratories' regular system. This situation is met by compressing steam at 125 *lbs./sq. in. to* 250 *lbs./sq. in. with this booster. Ralph Coviello is shown servicing the compressor*



spection trips, which followed, more specialized problems in the engineering of radio-telephone systems were considered in some detail. The general plan was for each class period to be handled by an engineer from the group responsible for the particular phase of the subject discussed.

The thirty-four students were entertained at dinner at the Downtown Athletic Club on February 6. Albert Tradup, Director of the Laboratories Training School, acted as toastmaster. The speakers included H. S. Osborne, of the A T & T; M. J. Kelly and A. B. Clark, of the Laboratories, and a representative from the Associated Company student group. About eighty men attended. The third school, with forty students, is scheduled for completion on April 5.

Coaxial Cable Demonstration

The direction of the coaxial cable demonstration, described on page 154, has been under L. G. Abraham. B. Dysart was in charge of the overall coaxial line. M. E. Campbell and E. E. Eddey were at New York on delay equalization of the line. Supervising the line were O. M. Akey at Princeton, O. D. Grismore at Elkton, C. L. Cahill at Baltimore, and W. R. Greer at Washington. R. E. Crane and R. L. Tambling at New York and J. P. Radcliff at Washington supervised the sound program circuits.

R. J. Shank was the observer at N.B.C. in contact with the program director and was responsible for liaison with the broadcasters during the program. J. W. Rieke and J. J. Jansen served as observers at the CBS and DuMont Studios, respectively.

The video facilities in Washington were installed under the supervision of H. C. Hey and R. W. Gutshall. The switching installation in Washington and contact with the originating points during the broadcast was under the direction of H. E. Powell. The carrier terminals at Washington and New York were under the direction of J. R. Brady and A. R. Kolding, respectively. The video facilities in New York were installed under the supervision of A. F. Mott, and were under his direction during the program.

April Service Anniversaries of Members of the Laboratories

40 *years*

P. T. Higgins
A. W. Lawrence

30 *years*

R. O. Burns, Jr.
A. W. Dring
F. E. Engelke
M. A. Froberg
Charles Haug
F. S. Mayer

25 *years*

E. L. Baulch
J. H. Connerty
D. H. Gleason
F. H. Hewitt
H. D. Kelso
C. D. Koechling
W. A. Marrison
W. I. McCullagh
Vincent Montagna
E. W. Olcott
M. O. Schrum
C. A. Smith
T. A. Spencer

20 *years*

A. L. Beach
R. W. Derrick
Stephen Doba, Jr.
H. C. James
Dorothy Muller
F. E. Nimmcke
H. E. Powell
L. J. Steinbach
T. J. Walsh
I. V. Williams

15 *years*

John Jordan
Patrick Murphy
R. C. Terry

10 *years*

A. L. Blaha
Louise Carbone
J. G. Compagnoni
Stephen Duma
Margaret Ely
C. E. Howard
F. J. Hurt
A. F. Mott
C. G. Schenk
J. A. Sierra
R. E. Strebel
Dorothy Washburn
J. J. Whelan

★ ★ ★ ★ We Welcome Back ★ ★ ★ ★

Alex J. Sandor had nine months' infantry training at Ft. Meade, Md., and then went directly to Australia. He was a heavy machine gunner and later a supply sergeant during thirty-one months of combat in New Guinea, the Dutch East Indies, Leyte and Luzon.

Col. Morton Sultzer's first four months in Washington on the staff of the OCSigO were spent as acting liaison officer with the OSRD. For a similar period he was assistant executive officer to Gen. R. B. Colton, Chief of the Supply Division, and conducted the selection and assignment of officer personnel. During the remainder of his stay in Washington, he was Assistant Director and Stock Controller in the Distribution Division of the Procurement and Distribution Service, OCSigO. He then went to Lexington, Ky., to become Director of Supply at the Lexington Signal Depot. From this assignment he went next to Philadelphia, where he was Director of Stock Control—Storage and Issue Agency. A year later he was assigned to Sacramento, Cal., where he had over-all command for Signal Sub-depots at Los Angeles, Seattle and the Oakland Army Base.

Charles D. Briggs was with the Joint Assault Signal Company of the 77th Division and was awarded four battle stars for participating in action at Guam, Leyte, Luzon and Okinawa. On the day of the signing of peace he was with the 1st Cavalry Division that entered Yokohama and was then assigned to Tokyo.

L. Charles Brown mastered radar at Fort Monmouth and Camp Murphy, Fla., and became a radar observer and technician in the 12th AAF. Action areas in which he was operating from a C-47 were the invasion of southern France, the Balkan air combat, the Po Valley campaign, Rome-Arno, Apennines and Rhineland campaigns.

Lieut. Col. Harvey N. Misenheimer was recalled to active service in January, 1941. After a brief period as assistant to the 1st AAF Signal Officer at Mitchel Field, he was transferred to Ft. Monmouth as a member of the Signal Corps Board and later to the OSS in Washington. In February, 1943, the scene of his activities changed to the Southwest Pacific area, where he was radio officer and later signal operations officer for the Army Service Forces at Sydney, Australia. At Milne Bay, New Guinea, he was base signal officer and later helped plan the invasion of the Philippines with the Army Service Command. For seven months he was the signal officer for all of New Guinea, and for his meritorious service in this responsible position he was awarded the Bronze Star Medal. Prior to V-J Day, Col. Misenheimer was located north of Manila with ASCOM-O, which was planning the invasion of Japan.

Sgt. Robert Beattie attended a photographic school at Lowry Field, Colo., and a B-29 school at Lincoln, Neb. He also trained for nine months in New Mexico as an aerial photographer and then went to an aerial staging base in Kansas.

Francis E. Tucker underwent basic training at Keesler Field, Miss., before being sent to the Air Forces Radio School, Sioux Falls, S. D., for an eighteen-week course. He became an instructor of radio theory. Later he transferred to Truax Field, Madison, Wis., to teach a course in radio repair.

Arthur M. Doyle was stationed at piers 86 and 90 in N. Y. C. for his first year of military service while he was with the Military Police. He transferred to the 51st Major Port in the Transportation Corps, and in England worked in the signal dispatch service routing official mail and handling teletype and cryptography. He later did the same work in Antwerp, Belgium.

Lieut. S. Milton Ray received special training at the naval supply corps school in Wellesley, Mass., and was assigned to the Naval Supply Depot, Clearfield, Utah. There, it was his responsibility to handle spare parts for all the Navy's ships in the Pacific. In March, 1945, he was made outgoing stores division officer in charge of 550 men who issued, assembled, preserved, packed and shipped about a million and a half pounds of small items per week to the Pacific fleet.

Albert L. Blaha joined the Merchant Marine in March, 1945, and served as a Third Radio Operator aboard a tanker which carried gasoline to Casablanca, Algiers, England, Saipan and Guam.

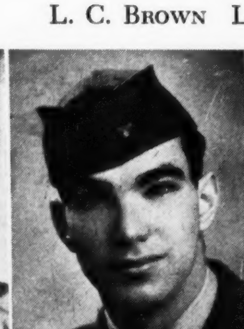
Col. Albert M. Elliott was a captain in the 244th CAC, NYNG, when it was ordered into Federal service, September 16, 1940. In 1941 he was placed on temporary duty as communications officer, First Army, during the Carolina maneuvers. Following December 7 he was assigned to First

A. J. Sandor

Col. Sultzer

C. D. Briggs

L. C. Brown



Lt. Col. Misenheimer

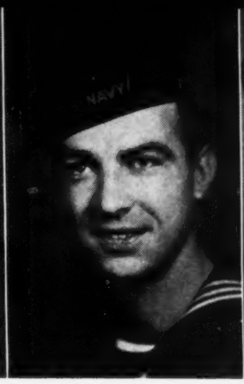
Sgt. Beattie


Lt. S. M. Ray


A. L. Blaha


Col. A. M. Elliott


Sgt. Richardson


J. W. Hoell


Col. Smith

Army Staff and stationed at Governor's Island. In May, 1942, he became Signal Officer of the Southern Sector which included the Southeastern U. S. mainland and Caribbean Island areas. Early in 1944, following a short assignment at the Ft. Monmouth Signal Corps School, he joined the staff of the Tenth Army which was formed at Ft. Sam Houston, and proceeded to Oahu. He was in Leyte and in Okinawa as Communications Officer, Tenth Army, and later Acting Signal Officer. He became Signal Officer of the Army Service Command, Korea, when U. S. Forces entered to accept the surrender of the Japanese.

S/Sgt. Watson Richardson went overseas early in 1944. In Hawaii the combat engineers were given further training in jungle fighting and amphibious work. He took part in the initial landing on Leyte, and also participated in the invasion of Okinawa and the occupation of Korea.

John W. Hoell, AETM 1/c, after attending radio and radar schools in Chicago and Texas, was assigned to radar operational flying with a Navy squadron at San Diego. As a flying technician on various type planes, he participated in patrol duty for fifteen months along the West Coast.

Col. Walter F. Smith, Jr., held the rank of Major in the Engineer Reserve in March, 1942, when he was ordered to duty with the Signal Corps at Fort Monmouth. Most of Col. Smith's military service was with the Office of the Chief Signal Officer, where he was responsible for the activities of the Ground Signal Maintenance Agency for two years in Washington and later in Philadelphia. Transferring to a Signal Base Depot Group activated at Camp Crowder, he was made responsible for organizing and training the engineering and technical personnel of the group, which included a large base shop company. The group moved to the mid-Pacific theater of operations with headquarters at Hawaii in December, 1944. As Director of the Engineering and Technical Division of this group, his work there had to do with the inspection, maintenance and repair of all signal equipment used by the ground forces; with the development of field modifications to signal apparatus to prevent equipment failures; and with the development of special signal equipment needed urgently by tactical units.

Gerard E. Campbell spent seventeen months with the supply section of the Engineer Corps in Yukon territory and western Canada during the construction of the Alcan Highway. After overseas training in Oregon, he was assigned to the 3rd Army and participated in campaigns through France, Belgium, Luxembourg and Germany.

John H. Geiger served in the European Theater with the 94th Infantry Division as a light machine gunner. He was captured by the Germans during the Battle of the Bulge and held prisoner for approximately three months.

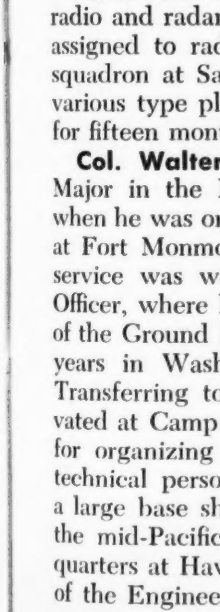
Joseph T. Grissom, with the Navy, attended electrical school in Detroit. He spent two years at Norfolk with the Advance Base Aviation Training Unit before his transfer to the U.S.S. *Albemarle,* a seaplane tender. He was last assigned to a carrier aircraft service unit at Grosse Ile, Mich.

Daniel F. O'Sullivan, U.S.M.C.R., after training at Camp Le Jeune and Parris Island, participated in the anti-aircraft defense of Tinian for a year and then spent two months at Saipan.

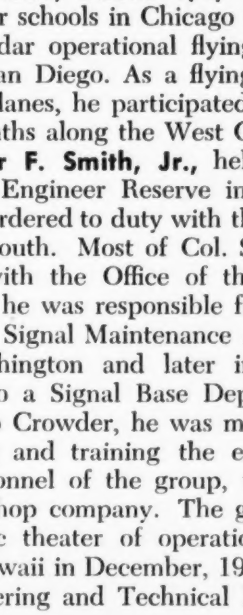
August Uhl joined the field artillery in 1942 and went to Hawaii, Guam, Leyte and Okinawa. During the invasion of Okinawa, he had charge of wire laying. He was also in "mopping up" operations at Cebu in the Philippines. Upon reaching Japan he was assigned to the occupation forces.

G. Warren Wheeler was at Ft. Knox with an ordnance depot company for three months. The next nine months he served there with the Military Police. In May, 1944, he went to Oran and later made the invasion of southern France with the 7th Army, ending in Kassel, Germany.

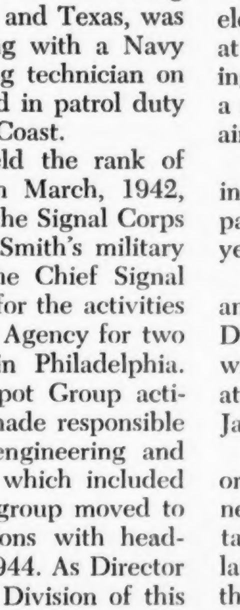
G. E. Campbell



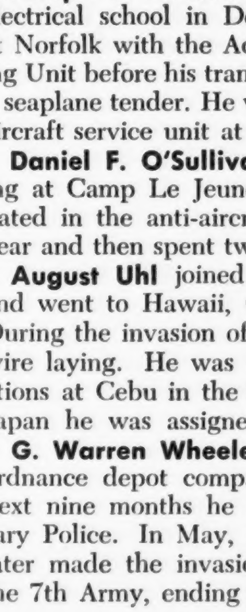
J. H. Geiger



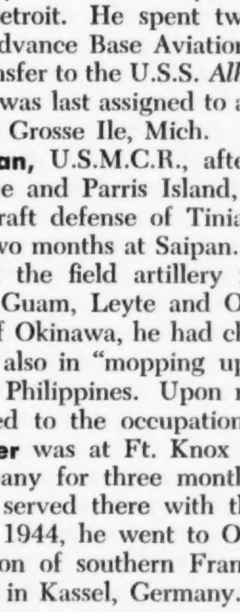
J. T. Grissom



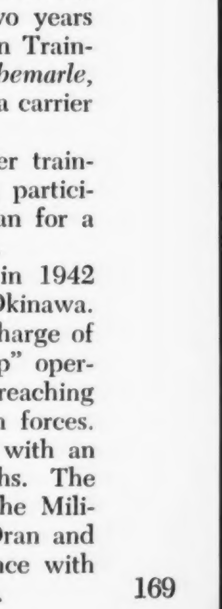
D. F. O'Sullivan



August Uhl



G. W. Wheeler

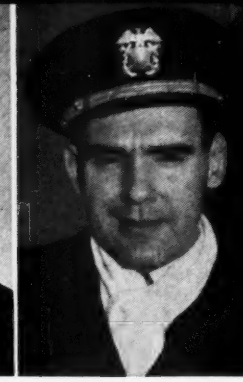



F. E. SCHELLHORN


SGT. MAJOROSSY


G. B. TAYLOR


L. J. KOOS


T. M. BRAY


COL. MCCANN

Frederick E. Schellhorn, RT 1/c, a radio technician, served on the fleet tug *Jicarilla* for 16 months in the Philippines, Iwo Jima, Okinawa and Japan.

Sgt. Frank G. Majorossy trained at Camp Crowder and, following an interim at Camp Knight, Cal., was assigned to Ft. Ord. There he worked with ordnance and later with the Military Police. Later he was a supply sergeant at Fort Lewis.

Gordon B. Taylor, EM 1/c, served on the submarine tender *Bushnell* at Pearl Harbor, and for a year was aboard the submarine *Thresher,* which sank sixteen ships on runs to Truk, the Philippines, China and the Yellow Sea. He was then assigned to the *Carp,* which patroled between the Kurile Islands and Russia, sinking a total of nine ships.

Louis J. Koos, RM 2/c, after training, shipped out of Boston on a new LST, aboard which he was a radio operator, and traveled to the New Hebrides, the Solomons, New Guinea, Philippine Islands, Okinawa and Korea.

Thomas M. Bray, after attending several schools, was assigned to the Atlantic Fleet for a short time to do radar matériel work. His next assignment was with the fleet in the north Pacific as radar matériel officer aboard the light cruiser U.S.S. *Concord,* which engaged in the bombardment of the Coral Islands. Following V-J Day, his ship took part in the occupation of northern Japan.

Col. Thomas A. McCann, III, entered military service in March of 1943 as a major in the Signal Corps. After eighteen months' service in Washington he joined the staff of SHAEF in London, where he earned his lieutenant colonelcy and served until its demise on June 12, 1945. He then joined the Military Government in charge of a subsection on re-organization of the Reichpost.

Lieut. Col. Henry E. Hill was ordered to active duty as a reserve officer in 1940. His first assignment was as a student at the Ordnance School, Aberdeen. He then served at the Ordnance Replacement Training Center, Aberdeen, later at Fort Bliss, Texas, and finally at Schofield Barracks, Territory of Hawaii. In the spring of 1944 he attended the Command and General Staff School at Fort Leavenworth. Afterwards he was assigned to the Ordnance Section of the Special Staff, Headquarters, Central Pacific Base Command.

Nicholas Stuber, in 1942, took his boot training at the San Diego Naval Training Station and was assigned to a ship repair unit based there for about two years before his transfer to Pearl Harbor.

William J. Chapp studied radio and radar repair but was later assigned to an anti-aircraft artillery unit which landed in Normandy on D plus 6. With the First Army he traveled through France, Belgium, and Germany with an AAA crew.

Donald F. Cuneo maintained aircraft fighter instruments at St. Simon's Island, Ga., studied the overhaul of aircraft instruments in Chicago, and served aboard the U.S.S. *Bogue* maintaining such instruments. Mr. Cuneo had charge of a maintenance shop in Hawaii for seventeen months which serviced southern-bound bombers.

Major Stephen Duma, upon receiving his commission in the Marines, was assigned to the M.I.T. Radiation Laboratories to work on the development of airborne night-fighter radar equipment. Then, at Quonset, R. I., he was responsible for outfitting with night-fighter equipment the first Marine Corps night fighters; for similar work at Quantico, Va., he received a citation for outfitting the night-fighter squadron for the Kwajalein campaign.

Lieut. John R. Boyle was commissioned at Corpus Christi, took an eight-week flight instructor's course at New Orleans and was a primary flight instructor at several naval air stations. Before V-J Day, he was training for overseas duty.

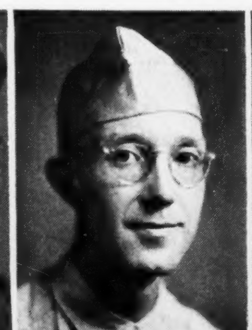
Sgt. Charles E. Kempf, after basic training as a clerk specialist, was sent overseas with a signal service platoon in March, 1944, and served as stock control clerk at Guadalcanal, Munda Point, Green Island, Bougainville and Leyte.

D. F. CUNEO

MAJOR DUMA

LT. J. R. BOYLE

SGT. C. E. KEMPF



E. B. KOPETZ

C. A. ARENA






Marie Vincent — Elena Tighe — W. A. Anderson — B. G. Bleecker — Capt. Turnbull — C. W. Muccio

Edward B. Kopetz served twenty-one months as a machinist's mate, thirteen in the Pacific on the submarine tender *Appollo*.

Charles A. Arena, F 1/c, studied at the Ford Naval Training Station in Detroit. He went overseas to Tinian and transferred to the Seabees, where his unit maintained an air strip. Later he spent a year in Guam doing similar work.

T/5 Raymond G. Bussman went to England in June, 1944, and then to France, Belgium, Holland and Germany. He fought with the artillery in the First Army. After V-E Day he remained on occupational duty in Frankenberg.

Marie T. Vincent, SpP 2/c, joined the Waves in July, 1943, and after training at Hunter College, went to the Naval Air Station at Anacostia. There it was her job to prepare copy to be reproduced by photolithography in the Graphic Arts Division of the Naval Photographic Science Laboratory.

Elena R. Tighe, Y 2/c, trained at Hunter College and at Oklahoma A. and M. College. She was assigned to the Bureau of Personnel, Navy Department, Washington, where she did secretarial and clerical work for nineteen months.

William A. Anderson, RT 2/c, was assigned as a radio operator aboard Liberty ships after completing a radio course at Sampson. He traveled to Africa and Italy, and later he attended a radio matériel school in the Naval Research Laboratory. Subsequently, on the escort carrier *Della Gulf*, he spent seven months in the Pacific.

Bruce G. Bleecker served fourteen months overseas in the 8th AAF as a radar mechanic and instructor in radar navigation. He is on the waiting list of those planning to enter Syracuse University.

Charles W. Muccio reached France on D plus 8 day with the 79th Division. He participated in the capture of Cherbourg and his unit, at various times, was attached to all Armies except the 5th.

Capt. William G. Turnbull, Jr., spent twenty-one months in the Central Pacific, first as commanding officer of the 67th Ammunition Ordnance Company and later as property officer at the Schofield Ordnance Depot. He then returned to the United States as training officer at the Aberdeen Proving Ground, and subsequently to the Office of the Chief of Ordnance, Washington.

Charles R. Hempel had three months' advance infantry training in New Caledonia before action on Iwo Jima, Tinian and Okinawa.

James Campbell was in combat in both the European and Pacific theaters. He maintained vehicles while serving with the 3rd and 9th Armies in France, Belgium and Germany. After V-E Day he took part in the invasion of Okinawa.

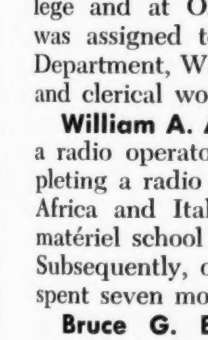
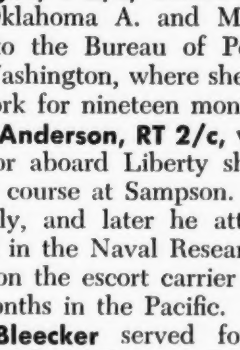
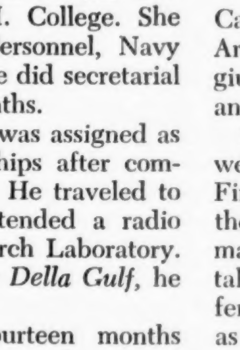
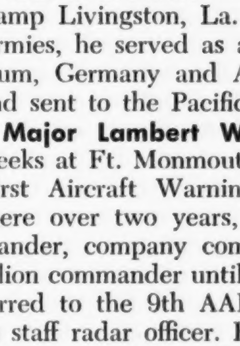
T/5 Theodore J. West was first a Signal Corps replacement upon arrival in Normandy and then a draftsman in the Signal Service Group Headquarters. He traveled with this headquarters through France and Germany.

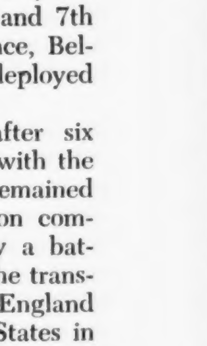
Walter E. Lichte trained at Fort Eustis, Va., and Camp Livingston, La. With the 1st, 3rd and 7th Armies, he served as a cannoneer in France, Belgium, Germany and Austria. He was redeployed and sent to the Pacific, serving at Luzon.

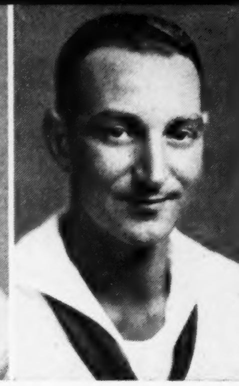
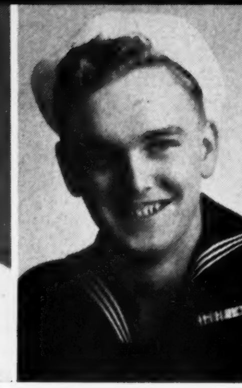
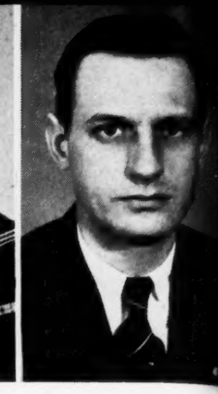
Major Lambert W. Stammerjohn, after six weeks at Ft. Monmouth, went to Iceland with the First Aircraft Warning Company. He remained there over two years, serving as a platoon commander, company commander, and finally a battalion commander until, in October, 1943, he transferred to the 9th AAF Headquarters in England as staff radar officer. He returned to the States in February, 1945, and was assigned to the AAF School at Orlando, Fla.

William J. Gallagher, EM 2/c, studied electricity at Iowa State College following boot training. He boarded the *Raymond*, a destroyer escort, at Boston, and for seventeen months saw the Solomons, Carolines, Saipan, Iwo Jima, Okinawa, Palau, Bougainville, Morotai, Leyte, Luzon, Yap, Truk, Formosa and Tokyo.

C. R. Hempel — James Campbell — T. J. West — W. E. Lichte — Maj. Stammerjohn — W. J. Gallagher



MARGARET KENNEY W. C. PRENDERGAST T. J. O'NEILL J. C. STANISCI R. C. LOCKWOOD M. C. RUGGIERO J.

Thomas J. O'Neill was awarded the Purple Heart for wounds received at Sharndorff, Germany, when he and his company were hit by 120 mortar fire just after they finished laying wires.

Robert C. Lockwood, as pharmacist's mate 2/c, saw naval service in Guadalcanal, the Russell Islands, Randova and Munda, earning battle stars for the last two engagements. En route to the Pacific he was one of the men who volunteered for duty during the passage and won a personal commendation from the Army for service.

The Laboratories has employed 762 veterans of World War II

Margaret M. Kenney spent most of her eighteen months of service in Washington, D. C., where as aerographer's mate 2/c she attended the Navy Weather Central.

William C. Prendergast, second assistant engineer on the U.S.S. *Robert Watchorn,* joined the Merchant Marine in February, 1945, and served in the Pacific theater from Honolulu to Okinawa.

Jack C. Stanisci, RDM 3/c, after boot training and radio school, had subchaser training at Miami, Fla., and followed it with radar training so that he became a radar operator on Admiral Turner's flagship, the *Eldorado,* of the Amphibious Group Command II. Aboard her he went to Mare Island, Pearl Harbor, Saipan, Iwo Jima, Guam, Samar, Okinawa for the invasions, following which he went to the Philippines.

Arthur T. Olsson learned teletype maintenance at Ft. Monmouth and had a refresher course in Brisbane, Australia. In Finschhafen, New Guinea, he installed and maintained teletypewriter equipment for sixteen months. He subsequently instructed at a Signal Corps training school in Manila.

Michael C. Ruggiero was in the Pacific Theater of Operations for approximately two years, where he was stationed at Seabee bases at Milne Bay, New Guinea and at Basilan Island and Subic Bay in the Philippines.

Lieut. Joseph A. Lehans studied radar at Harvard, M.I.T. and the Naval Air Technical Training Center, Corpus Christi, Texas. He served aboard the combat escort carrier U.S.S. *St. Lo* for a year as radar officer during combat operations in the South Pacific. His ship was sunk off the Philippines in October, 1944, and he returned to the Naval Air Transport Service in Miami as loran training officer and airborne electronic officer. In August, 1945, he transferred to Patuxent River, Md., as radio maintenance officer.

Sgt. Alfred T. Stiller's initial assignments were with the Military Police—first in the United States and later in England. Then he transferred to the infantry and was in combat for seven months in the Ardennes, Rhineland and Central European campaigns.

T/4 Louis A. Kramer was assigned to Camp Joseph T. Robinson, Ark., and then went directly overseas to New Caledonia. He was attached to a Seabee battalion doing malarial survey on Guadalcanal and the Philippines.

Lieut. Frank L. Krzyston was a B-17 pilot on thirty-two missions with the 8th AAF. After his return to the States he attended the Army Airways Communications School at Chanute Field, Ill., and later went to South America to assist in the installation of beacon and range systems.

Gordon J. MacDonald, SK 3/c, upon completion of boot training, was at a naval induction station in Cincinnati for six months. He spent the balance of his military service at Great Lakes.

LT. J. A. LEHANS SGT. A. T. STILLER R. C. BOGSTAHL C. H. HAMANN F/O HOSHOWSKY H. S. HOPKINS






J. R. Nelson | S. Gutierrez | O. C. Kanouse | S/Sgt. Willdigg | Lt. J. C. Young | S/Sgt. Sauer

Richard C. Bogstahl, after training, was, for two years, an electrician's mate on the destroyer U.S.S. *Amick* which did convoy duty to Sicily, North Africa, and the Azores. He then had two months' duty in the Pacific.

Chief Petty Officer Carl H. Hamann attended a Navy radio school for airborne equipment at Corpus Christi, Texas, and went to California to repair radio and radar sets on B-24's. He served two years in charge of aircraft radio and radar on the carrier U.S.S. *Solomons* in the Atlantic area.

F/O William V. Hoshowsky made the grade as a single engine pilot in Alabama. He transferred to flight engineering on B-29's and took courses at Lowry Field, Denver, and in Nebraska. He was awaiting overseas assignment when discharged.

Howard S. Hopkins landed in Naples after brief infantry training and was a rifleman during the Rome-Arno campaign. With the 79th Division, he went through France, Belgium, Holland, Luxembourg, Germany, and Czechoslovakia.

John R. Nelson was an electronic electrician's Mate 1/c when discharged, and in the Navy worked on the maintenance of electronic circuits for sub-surface equipment.

Sebastian Gutierrez, with the 47th Engineers, went to Hawaii and continued on to the Marshall Islands, where he participated in the beach party invasion. In Saipan, he assisted in the construction of a pier, and later in Okinawa he helped build air fields, roads and a pier.

Oliver C. Kanouse served overseas twenty months in the Central Pacific theater and took part in the campaigns at Guam, Leyte, Ie Shima, Okinawa and Japan.

S/Sgt. William L. Willdigg was a central office repairman in Milne Bay and Finschhafen, New Guinea, and installed switchboards at Manila. He landed in Yokohama on September 1 and worked with the GHQ Mobile Unit there and in Tokyo.

Lieut. Joseph C. Young, a fighter pilot, had to his credit 500 log hours, of which eighty-seven were combat duty. He completed seventeen missions over enemy territory, flying a P-47 airplane in the South Pacific. A crash landing on Okinawa put him in the hospital for two months.

S/Sgt. Wilbur G. Sauer enlisted in November, 1942, and trained as a paratrooper. He was assigned to the 82nd Airborne Division overseas and made his first jump in Normandy on D-Day. His second jump was made in Holland, after which his division was assigned during the "Battle of the Bulge" to the defense of Liege, Belgium.

Raymond J. Martin, AM 1/c, went to mechanic's school and gunnery school before assignment to Hedron Fleet Air Wing at Oak Ridge, Wash., where he did maintenance of aircraft. He was in the Aleutians one year on PBY operational duty and later in Hawaii. His last station was on Okinawa, operating a carrier service.

Lieut. Kenneth C. Oestreicher received his commission at San Marcos, Texas, and as navigator of their B-24, flew his crew over to Italy. He made twenty-eight combat missions with the 15th AAF. Wounded on his last mission, he returned to the States for hospitalization.

Gerald K. Oestreicher, brother of Kenneth, served as an aircraft armorer with a fighter squadron of Marine Air Group at Ulithi and Okinawa.

Leaves of Absence

As of February 28, there had been 1,031 military leaves of absence granted to members of the Laboratories. Of these, 469 have been completed. The 562 active leaves were divided as follows:

Army 278 **Navy 204** **Marines 23**

Women's Services 57

There were also 16 members on merchant marine leaves and 2 on personal leaves for war work.

Recent Leaves

United States Navy—Thomas J. Kelly

United States Army

Fred W. Kamps | Alfred A. Schwarz
Thomas S. Melahn | Edward T. Seckel
Robert J. Kelly

R. J. Martin | G. K. and Lt. K. C. Oestreicher


George Gerry, 1895-1946

George Gerry, who retired in December, 1944, after twenty-seven years of service, died on March 6. Mr. Gerry joined the Western Electric Company in 1917 as a sheet-metal worker in the Building and Maintenance Department. Shortly thereafter the sheet-metal group was combined with the Model Shop, now the Development Shops. In addition to the usual run of work passing through the group, Mr. Gerry worked on the construction of a diving helmet for underwater work and on the fabrication of some of the larger type loudspeakers.

News Notes

R. W. King spoke on *Some Aspects of the Pending Legislation on Science* at the February 12 meeting of the Cornell Chapter of the Society of Sigma Xi.

L. A. MacColl delivered the fifth lecture in the Servomechanisms Symposium at Columbia University on March 13 under the auspices of the Basic Science Group of the A.I.E.E. His subject was *Non-Linearity in Servomechanisms.*

"Hot house" crystals grown from seeds were described to chemists of the North Jersey Section of the American Chemical Society by A. N. Holden at a meeting of the section at Elizabeth, N. J.

F. S. Malm attended a meeting in Washington, D. C., of the Hard Rubber Consulting Technical Committee of the Civilian Production Administration.

C. V. Lundberg visited the Church Rubber Company at Monson, Mass., to discuss problems encountered in the manufacture of sponge rubber ear pads.

D. A. McLean and A. J. Christopher at Hawthorne discussed paper and other capacitor problems.

W. E. Campbell attended meetings of the A.S.T.M. Committee D2 on Petroleum Products and Lubricants at Cleveland.

L. L. Lockrow is author of *Development Supervision,* which appeared in the February, 1946, issue of *Modern Management.*

J. C. Osten has accepted the chairmanship of Sub-Committee No. 59, *Correlation of Infra Red and Convection Oven Baking,* sponsored by the Technical Committee of the New York Paint, Varnish and Production Club.

H. H. Glenn and C. A. Webber visited Point Breeze on new designs of cords.

H. H. Staebner discussed cord development problems at Point Breeze.

R. T. Staples went to the Ansonia Electrical Company, Ansonia, Conn., on problems relating to cable designs.

W. R. Lundry and R. S. Graham at the Philadelphia office of Long Lines made adjustments for the delay equalizers for the Washington-New York television circuit.

W. E. Kock presented a paper *Metal Lens Antennas* at the I.R.E. 1946 Winter Technical Meeting held from January 23 to 26 in New York.

W. H. Doherty spoke on *Radar* on February 19 at the Norris County Engineers' Club, Dover, N. J.

R. O. Grisdale and P. S. Darnell visited the Battelle Memorial Institute at Columbus, Ohio, to discuss developments on metallic film type resistors.

P. S. Darnell attended a meeting in Philadelphia of the Radio Manufacturers' Association sub-committee on resistors.

J. W. Kennard and J. G. Brearley were in and near Dallas, Texas, in connection with the installation and testing of the Dallas-Fort Worth cable.

"The Telephone Hour"

NBC, Mondays, 9:00 p.m.

April 8	*Helen Traubel*
April 15	*Fritz Kreisler*
April 22	*Robert Casadesus*
April 29	*Metropolitan Opera Ensemble**
May 6	*Lily Pons*

*Jarmila Novotna, Soprano; Hertha Glaz, Contralto; Raoul Jobin, Tenor, and Martial Singher, Baritone.

M. WHITEHEAD and R. E. DRAKE discussed electrolytic capacitor problems at the Sprague Electric Company, No. Adams, Mass. Mr. Whitehead also visited the Aerovox Corporation, New Bedford, Mass., on similar problems.

J. E. RANGES spent a week at Hawthorne in connection with the manufacture of a submarine loading coil case.

C. D. HOCKER, as Chairman of Committee A-5 on Corrosion of Iron and Steel, held a meeting of the committee at the A.S.T.M. Spring Group Meetings in Pittsburgh, February 25 to 28. Also attending meetings at the convention were J. B. DIXON, A. P. JAHN and W. H. S. YOURY.

A NEW SYSTEM of transmitting television signals by radio is being designed in the Laboratories for use between Hollywood and the top of Mt. Wilson. Various broadcasters will set up their television transmitters for the Hollywood-Los Angeles area on Mt. Wilson and this telephone company link will connect the various local pickup points with them. One of the important pickups for these broadcasting stations will ultimately be the coaxial cable coming into Los Angeles from points farther east in the United States. R. P. BOOTH, K. D. SMITH and J. F. WENTZ have discussed this installation with members of the Southern California Telephone Company.

R. M. HAWEKOTTE, J. L. LINDNER, A. B. LUND and R. S. TUCKER, in coöperation with members of the Engineering Departments of the New York Telephone Company and the New Jersey Bell Telephone Company, made radio noise tests in New York City and Newark.

R. S. TUCKER attended meetings of War Committees C63 and C63A of the American Standards Association held in New York. He is chairman of C63A, a committee working on radio noise meters.

W. C. TINUS addressed the Lehigh Valley Engineers' Club at Lehigh University, Bethlehem, Pa., on February 19. Illustrated with slides, his subject was *Early Fire-Control Radars for Naval Vessels.*

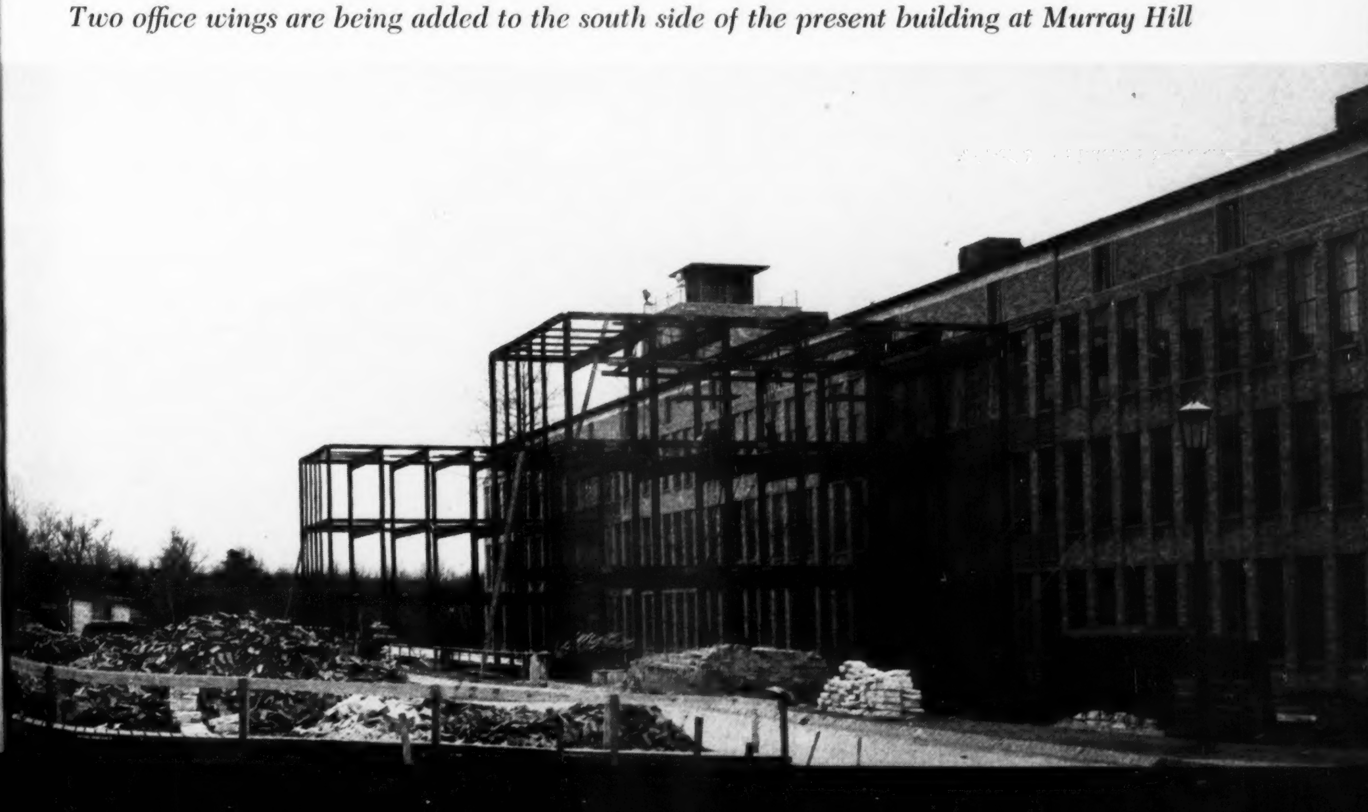
P. W. BLYE spoke on *Rural Power Line Telephony by Carrier Methods* before the Louisville, Kentucky, section of A.I.E.E.

E. E. SCHUMACHER and J. H. SCAFF were in Chicago attending the American Institute of Mining and Metallurgical Engineers' meeting and visiting Hawthorne.

F. B. LLEWELLYN, President of the I.R.E., has written a foreword in the January *Proceedings of the I.R.E.* on the responsibility of the engineer in guiding the destiny and application of his work in addition to his responsibility in dealing with the technical aspects of radio and electronics problems. Dr. Llewellyn discusses the I.R.E.'s plans to help the engineer in that direction.

S. A. SCHELKUNOFF's *Principal and Complementary Waves in Antennas* appears in the January, 1946, *Proceedings of the I.R.E.*

Two office wings are being added to the south side of the present building at Murray Hill



Please put your RECORD in the "Correspondence-Out" box when you are through with it so that it can be sent to a Serviceman's family.

Robert E. Graham and F. W. Reynolds are authors of *A Simple Optical Method for the Synthesis and Evaluation of Television Images,* a paper appearing in the first issue of a new technical journal, *Waves and Electrons,* January, 1946, bound in as a dual publication with the *Proceedings of the I.R.E.*

U. B. Thomas, Jr., F. T. Forster and H. T. Langabeer visited Roanoke to make tests on central office storage batteries.

V. J. Albano visited Pittsburgh to discuss cable sheath corrosion problems with engineers of The Bell Telephone Company of Pennsylvania.

F. T. Meyer visited Norwalk and Danbury, Conn., with members of the Western Electric Company to study problems in numbering and lettering in connection with toll equipment.

D. H. Wetherell, at Hawthorne, discussed the No. 1 crossbar system; and E. T. Ball, J. G. Ferguson, J. E. Greene and R. L. Lunsford, the No. 5 crossbar system.

C. E. Boman visited Cleveland to discuss teletypewriter switching systems.

G. A. Benson was at Langley Field to discuss a computer system for the N.A.C.A.

V. T. Callahan and J. M. Duguid visited the Ready Power Company in Detroit, the Duplex Truck Company in Lansing and the U. S. Motors Corporation in Oshkosh to investigate gasoline and diesel engine alternator sets and automatic control.

R. D. Fracassi, E. K. Van Tassel and A. H. Lince have been at High Point Park, N. J., during February and March engaged in field trials of equipment being designed for the Marine Corps.

A. D. Knowlton, A. L. Stillwell, J. F. Wentz and J. W. Rieke were in Philadelphia to discuss television equipment at RCA Victor.

I. L. Hopkins, in Pittsburgh, attended an A.S.T.M. committee meeting which was devoted to rubber products.

J. T. Schott attended the winter meeting of the Edison Electric Institute in Cincinnati on February 18, and gave a talk on the *Lookator* before the Committee on Transmission and Distribution.

J. P. Radcliff spoke on *A Brief Story of Radar* to the Curie Club of the New Jersey College for Women.

S. B. Williams and T. C. Fry attended a demonstration of the ENIAC, which is the name of an *Electrical Numerical Integrator and Calculator.* This device was developed by the Moore School of Electrical Engineering at the University of Pennsylvania at Philadelphia, where the demonstration was held on February 1. Two weeks later Mr. Williams attended the formal ceremonies which dedicated the ENIAC.

Harvey Fletcher gave a lecture and demonstration on *The Pitch, Loudness and Quality of Musical Tones* before the New York Patent Law Association at a dinner at the Waldorf-Astoria.

K. K. Darrow spoke on *Nuclear Energy* before the technical societies of Charleston, W. Va., on January 31; before the American Society for Metals at Detroit on March 4; before the Communications Section of the A.I.E.E. in joint meeting with the I.R.E. on March 11; and before the students of Brooklyn Polytechnic Institute on March 12.

H. E. Ives, E. K. Jaycox, K. H. Storks, F. W. Reynolds, H. W. Dudley, J. A. Becker, W. H. Brattain, H. R. Moore and J. D. Struthers attended the Optical Society meetings in Cleveland from March 7 to 9. Dr. Ives also attended meetings of Division 16 of the N.D.R.C.

We regret that in the March Record the engagement of Barbara Taylor to Lieut. D. R. Schoen was inadvertently listed under "Weddings."

During the month of January the United States Patent Office issued patents on applications previously filed by the following members of the Laboratories:

W. M. Bacon	A. A. Lundstrom
M. W. Baldwin, Jr.	R. F. Mallina
L. J. Bowne	R. G. McCoy
A. J. Christopher	A. C. Norwine
W. A. Depp	C. E. Pollard, Jr.
B. Dysart	W. T. Rea
G. Hecht	R. A. Sykes
R. E. Hersey (2)	D. E. Trucksess
A. E. Joel, Jr.	G. W. Willard

BELL LABORATORIES RECORD
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